PUBLIC WORKS IN INDIA:

THEIR IMPORTANCE.

With Suggestions

FOR

THEIR EXTENSION AND IMPROVEMENT.

BY

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ADVERTISEMENT.

This treatise on "Public Works in India," was written for private circulation. It contains such a mass of information, and of powerful reasoning, upon a subject of vital importance to India, that the friends of the writer to whom it was addressed think it their duty to give it publicity. How we shall best spend our money upon public works in India, is a subject in which England, also, has a deep interest; for it involves, amongst other things, the great cotton question. By a judicious expenditure, we may render ourselves independent of the slave-grown cotton of America. On the other hand, we may spend millions without approximating to such a result; and as the interest of these millions is to be paid by the people of India, it is our obvious duty to spend it in a manner that will be most conducive to their advantage. How this may be done is a question that is thoroughly discussed in the following pages.

ON

PUBLIC WORKS IN INDIA.

INTRODUCTORY CHAPTER.

THE object of the present Essay is, to try to induce those who are capable of such an undertaking, to investigate the subject of communications in India as a whole. I cannot find that this has ever been attempted. So far as I have been able to ascertain, whatever has been done in the case hitherto has been done as a patch. One man has thought it would be very nice to travel at the rate of 40 miles an hour, from such a place to such a place, and he begins to examine whether this can be accomplished; and he thinks that if a railroad on that line would pay the interest of the capital expended on it, or if it will pay part of it, and he can get the Government to make up the deficiency, the whole subject is exhausted. Whether it is the best way of accomplishing his object, whether *his* object is *the* object even on that particular line, whether this work will form part of a whole system of works adapted to India, whether it will hinder or help forward the welfare of

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India generally, so far as that will be affected by suitable communications, and many other points of a general nature, have not been at all considered. So far as the shareholders are concerned, it may be thought sufficient for them if there is a fair presumption that good interest will be returned for their money, but it cannot be the whole of the question to the Government and those who are interested in the welfare of India. Nor is it even the whole of the subject to the shareholders. They have not only to ascertain that such a work will pay, but that it is so nearly the best and most suitable one, considering the peculiar circumstances of the case, that it will not be in danger from a better-planned rival.

Of the superficial way in which the question has been considered hitherto, even taking it in its narrowest view, and thinking only of the point, whether a railroad on a certain line will pay, we have a curious instance in the Calcutta Railway. The traffic is there, and it is proposed to construct the railway, and calculations are given to show that such a traffic on such a railway will pay such interest; but whether the railway, when it is ready, can carry the traffic, has not been considered. The traffic is 1½ million tons a year, or 5,000 tons a day, on an average of the whole line and of the year; which, of course, implies, that at the busy time of the year, and near Calcutta, there will be at least 10,000 tons a day, besides 1,600 passengers. Can a double

railway carry 10,000 tons a day, besides 1,600 passengers? The busiest passenger railroad in England only carries 700 tons a day, on an average, according to Lardner, or one-seventh of the quantity upon which these calculations are based. We have no data as to what amount of goods a railway worked at high speed for passengers can carry, but we know certainly that it could not carry 10,000 tons of goods a day; so that, when the road is finished, either only a small part of the goods can be carried, or additional rails must be laid, or it must be worked at one speed for all, both goods and passengers, and that a very low one; any of which expedients, however, entirely overthrowing the calculations of profit.

If a great national question is thus taken up, without a careful investigation of the whole subject, there can be no hope of its being wisely managed. We must form some distinct idea of the actual importance of the subject, of the extent of the loss in the present state of things, of the precise nature of the evil, of the amount of labour and expenditure required to counteract it, of the difficulties that we may expect to encounter, of the value of time in applying a remedy, &c., before we can set about the matter in an effective way; in short, we must count the cost, if we hope to finish the work. If we have not some tolerable measure of the amount of evil before us, we shall either be continually liable to give up the attempt to obtain a remedy, upon every

difficulty that we encounter; or, on the other hand, we shall be wasting our money and our energies on a remedy for an evil which is not worth so great efforts and sacrifices.

There cannot be any greater proof of the evil consequences of doing things without any general investigation, than the history of communications in India up to this time, the desultory way in which the matter has been attended to, and the consequent failures and waste of money that we have seen. While the loss from want of communications was so great that there were a thousand ways and a thousand plans in which money might have been expended with the greatest advantage, perhaps crores of rupees have been thrown away from a total want of judgment in managing the expenditure.

A sketch of our first attempts at road-making in the Madras Presidency, may be of great use as a guide, and a warning to us in our future proceedings. It was assumed that all that was necessary to successful road-making was, a given number of men with tools in their hands, headed by an officer taken at random from the line, and without any scientific qualifications whatever. Bodies of pioneers, thus equipped and commanded, were placed upon a line many hundreds of miles in length, and when it was found that but little impression could be made upon such a surface, the remedy was, to add thousands of coolies, and thus, besides the cost of the pioneers, lacs of rupees were wasted in an attempt to do by mere

labour what could only be effected successfully by labour under the direction of science.

The road from Masulipatam, on the coast, 300 miles north of Madras to Hyderabad, a distance of 220 miles, was one of those executed in this manner. When about eight lacs of rupees (£80,000) had been spent upon it, besides the pay of the pioneers, the Court of Directors put a stop to it; and as no metal of any kind was put on most of it, the road has never yet been practicable in the wet season; and even in the dry season, the communication is very little better, if at all, than it was; only about 120 miles of the whole distance was meddled with; the money spent was therefore nearly 7,000 rupees* a mile, or twice as much as would make an excellent metalled road, and quite as much as would have made a good horse railroad (for there is not a single difficulty on the line), which would have reduced the cost of transit to one-twelfth of what it was and still is. The road from Madras to Poonamallee, eleven miles, was a similar case; and as in this case the pioneer officer was able to communicate constantly with the

* 1 rupee	2*s.*
1 anna	0*s.* $1\frac{1}{2}$*d.*
1 pie	half a farthing.
16 annas	1 rupee.
12 pies	1 anna.
100,000 rupees . . .	1 lac.
100 lacs	a crore.
A lac of rupees . . .	£10,000.
A crore	£1,000,000.

authorities in person, he was not so restricted about expenditure as in the other case; and accordingly 4,50,000 rupees were spent on this line, or 50,000 rupees a mile. The Court of Directors now saw that it was necessary to apply a remedy; and it was, to order that no more roads should be made. This was simple and effective.

Nevertheless, after some years, another line of road was commenced by the Government; and this time the really most important direction in the presidency was selected,—viz., that leading from Madras directly into the interior, 120 miles. But exactly the same mistakes were made about its execution. It was put under a non-professional officer; not a single engineer was employed upon it; the line was badly selected; enormous labour was wasted on it, and it was not in any sense completed. In England no work is undertaken without endless discussions. The wits and experience of hundreds of professional engineers are brought to bear upon it, and of tens of thousands of others, men of common sense and local knowledge; and yet after all, great mistakes are often made: what must be the case when not a single man of professional knowledge and experience is employed upon a work, and not the least attempt is made to get the opinions and help of the public generally? This road cost 10,000 rupees a mile, much more than a horse railroad need have cost. It was however a work of immense value,

imperfect as it was; there has been an enormous traffic on it, and it has saved in the cost of traffic much more than 100 per cent. on its cost; the rate of transit has been reduced to about one-third of what it was previously.

These desultory proceedings, however, of course, upon the whole, only retarded the general improvement of the communications. At length, something like a systematic attempt was made to introduce roads into Madras. A road department was formed with the approval of the Court; but the same error was committed of having no thorough investigation or open discussion. A professional officer was indeed appointed; but as he had charge of all the main roads of the presidency, and only two assistants, he was completely lost in his duties; and everything was still done in the same way without open discussion. Some work, however, was really done. The great road from Madras above mentioned was much improved, and some other lines commenced. But now a new difficulty arose. The local government would not sanction the expenditure which the Court had authorized; and the superintendent of roads was so cramped in every way, that though he wore himself out in his work, but little was effected.

This outline is of great importance to show what the real state of things has been, and why no real progress has been made here and generally in India in opening the country.

The great line from Calcutta to the north-west is almost the only important work that has yet been executed; and after all it is but a common road. Some real progress has, however, also been made of late years in the north-west in improving the roads, and one step of real progress has been commenced upon in the cutting of the Ganges canal. When this work is opened, there will be 400 miles of cheap and expeditious communication on one of the most important lines in India. The cost of transit in this will probably not exceed half a pie per ton per mile. This is certainly the first, and at present the only step towards opening India. Till such *cheap* communications are opened, nothing at all is done.

Had this subject been taken up systematically, and if we had had before us in figures the tremendous incubus that the cost of transit is upon the country, it is impossible that matters could have gone on in this way. A real apprehension of the importance of communications would have certainly led to such an attention to the subject, that the Department of Public Works would have been considered one of the very first in the State.

Certainly, without any exaggeration, the most astonishing thing in the history of our rule in India is, that such innumerable volumes should have been written by thousands of the ablest men in the service on *the mode of collecting the land revenue*, while the

question of a thousand times more importance, how to enable the people to pay it, was literally never touched upon; and yet even the question of the *amount* of taxation was utterly insignificant in comparison with that. While we have been labouring for a hundred years to discover how to get 20 lacs out of a district which is not able to pay it, not the least thought has been bestowed on the hundreds of lacs it was losing from the enormous cost of transit, which swallowed up all the value of the ryot's produce, if they raised it. The roads are not the only public works that are wanted: irrigation also is in this country of the very first importance; but no irrigation will bring the country to a state of great prosperity without the means of conveying produce to a market; and cheap communications will have an immense effect even in enabling one part of the country to help another in the matter of food, if local rains fail.

But our present inquiry is about communications only. This is not a question whether a railroad will pay on a certain line of 100 or 1,000 miles; the question is, What is the importance of providing all India with communications, and the best mode of doing so, considering the various circumstances which affect the case? Till the subject is taken up on this ground, nothing effectual will be done. Any particular lines improved will be just as likely to hinder as to help the great work. It is certain, that up to the commencement of the railroads, the individual works undertaken

in this presidency were the main hindrances to a system of communications. Instead of learning from the mistakes that were made how to set about this important work in future, we have only concluded to do nothing. And for the last four years, since the railroads have commenced, they have completely blinded the Government and others. They have effectually prevented any real attempt to open India. While millions of words and lacs of rupees have been expended on a few miles of road in two corners of the country, the whole of India has been lying untouched in the same miserable and disgraceful state as before. Had not this ill-considered expenditure been going on, perhaps the Government or the English public might have employed their time in commencing upon a real and general project for giving all India *cheap* communication.

Some symptoms of a change of views in the matter have now, indeed, begun to appear, but nothing whatever that gives the least indication of a right understanding of the case. The ordering four lacs to be spent where 400 would be insufficient; the attempting to accomplish these vast works by means of the present revenue; the appointing one officer to do what twenty could not do; the permitting the local government to obey their orders in the matter, or neglect them, as they choose; all these distinctly show that the whole subject is still misunderstood, and that we still cling to the notion, that if the collecting the

revenue is attended to, everything else will follow of course. The converse is very nearly true. If a collector were only allowed and required to spend liberally on public works, the revenue would undoubtedly follow in general; though certainly some intelligence would be required in managing it. A collector would require no sanction for money from the treasury, his district would provide the interest for whatever money he required, and abundance of increase of revenue besides. The saving in the cost of transit on the Western road from Madras is fully cent. per cent. on the capital expended; and the average return on all the new irrigation works in the Madras Presidency, for the last fourteen years, is 70 per cent., taking the whole of the years since their execution; the *present* annual profit is at least cent. per cent., and that without counting the improvement of private property.

If only the communications, irrigation works, and ports, were properly attended to, the questions about revenue systems would almost solve themselves; at least they would certainly be as little thought of as they are in England, where we do not hear of nine-tenths of the time of Parliament being taken up in investigating this mere question, whether the land-tax shall be collected ryotwar or mowzawar. If the people of India were abundantly able to pay the taxes, the mode of arranging the land-tax would be soon treated as a very secondary question. If intelligent

natives went to England they would be astonished beyond measure, seeing the inconceivable effect of cheap transit, that the English in India had been content to throw away all their own ideas on the subject. Instead of bringing their western knowledge, energy, activity, and common sense, into play, they have followed the example of their native subjects, — of a people without books or science. When the English begin to think for themselves, and bring their own Anglo-Saxon notions fairly to bear upon India, there will be a wonderful change. A native is by nature a very intelligent being, but he is utterly without our advantages. Imagine what a nation of Anglo-Saxons would be who had not one single book worth reading in their language, and who had learnt nothing from books but the drivelings of the Hindoo religious writings, which they themselves could see to be utter nonsense. Yet such are the people we are content to learn from, instead of teaching them.

Where did the notion come from, that the grand point upon which the whole body of men employed in the government of the country were to employ their wits day and night, was how to *collect a revenue*, which the people could not pay, or whether they could pay it or not? This was purely a native idea, and that of the lowest kind. The old public works of irrigation now existing show plainly that at some times and in some places, natives have had some

idea that there were things of more importance than *collecting the revenue.* It is strange that we should not have been roused by the sight of these valuable works, so far even as to make it a point to keep up the works already existing. The very name of the local controllers of the revenue shows unmistakeably how low an idea was formed of the duties of Government; they were called simply *collectors*, clearly implying that that was the leading idea, and the supposition that all other things could take care of themselves.* If they had been called directors of

* This misnomer was pointed out more than thirty years ago, by Sir Thomas Munro. "He," said that great man, "who is called collector, exercises the whole of the internal administration of the province. His designation is an unfortunate one, and ought to be changed, as it leads to the belief that the collection of the revenue is his sole duty, and that he is a mere tax-gatherer; but the collection of the revenue is a very subordinate part of his duty; it extends to every branch of the finance, and its influence is felt in the prosperity of the inhabitants. He watches the operation of the different existing taxes, points out such as are oppressive, that they may be lowered, or altogether abolished. In every country the amount and distribution of taxation are perhaps the most important concerns of public authority; there are no others on which, as on them, the universal comfort and prosperity of the people depend. In this country the management of taxation rests almost entirely with the collector; for he is the only channel through which the Government can obtain any tolerable correct information on the subject, and it is chiefly from his opinions that their own must be formed."

public works, or some such title, it would have been understood that the collection of the revenue was only a secondary matter, and a thing that would follow of course, when the people were enabled easily to pay it. What wonderful infatuation is shown to this day in this matter! The district of Tanjore is taken care of, irrigated, protected from floods, drained, and provided with common roads (though not with better communications), and the revenue steadily rises till from 30 it becomes 50 lacs a year; the population increases from 7 or 8 lacs to 15 lacs, and the land reaches a saleable value of at least four millions sterling, equal to 24 millions in England. In the district of Guntoor all such works are utterly neglected; and in one year a famine occurs which sweeps away 250,000 people out of 500,000, and causes a loss of revenue in the next ten or twelve years of 80 lacs, while not an acre of land is saleable. The sole cause which has made this difference between these two districts is the different degrees of attention given to public works. I challenge the most brilliant collector (let him belong to any class of revenue men you please, ryotwar, village settlement, zemindaree, or anything else) to show how he could have saved this unhappy district from these inconceivable horrors, and the treasury from this enormous loss; and on the other hand, send the most indifferent man to Tanjore, and see if he could have prevented its progress, if only the public works

had been attended to. A difference he might have made, certainly, but he would have found it hard to reduce the population to 300,000 and the revenue to 15 lacs, and to have kept the land unsaleable.

And what would have been the progress of Tanjore if, instead of the miserable petty expenditure that has been allowed it (about 80,000 rupees a year, or one-fiftieth of the revenue), a really liberal expenditure, equal suppose to one-tenth of the revenue, had been reserved for this purpose? Probably the district is at this moment paying at least 30 lacs a year for the actual cost of transit, and losing much more in the value of things that cannot be moved from where they are produced to where they would be saleable, so that at the very lowest estimate, it is paying a sum equal to the whole revenue, or 50 lacs a year, for want of proper communications. And ought not Englishmen to know that communications are an essential, if not the fundamental, element of national prosperity and wealth? Is this a thing that is now to be brought forward as a discovery? Could any man, born and bred in England, suppose that they were matters of utter insignificance not worth a thought in comparison of *collecting the revenue?* Now supposing that a system of communications had been introduced into Tanjore which would have taken away nine-tenths of the cost of transit, and enabled the people to move everything that was worth one rupee a ton more in one part of the district than

it was in another, so that it would have had an additional income equal to the whole present revenue, what would have been the state of it by this time, and how small a degree of skill and effort would have been required in a *collector* to *collect* the present amount of revenue, when it formed so small a portion of the annual income? It might be supposed that it would be very intelligible that the shortest way to remove the difficulties in *collecting the revenue* of 50 lacs would be to increase the income of the district 150 or 200 lacs. On the other hand, suppose we were to destroy the roads, canals, railroads, harbours, steam-engines, &c., in England, and then try to obtain a revenue of 50 millions by means of a splendid revenue system and crack *collectors*. Could all the wisdom of Parliament extort 50 millions a year out of the country, or even five? and yet this is the only expedient that has yet been tried to facilitate the *collection* of the revenue in India.

And this too after the indisputable proofs of the effects of such works on the spot. A statement, already alluded to, has lately been printed of the return from forty works of irrigation, including all that have been executed of any consequence in fourteen years in the Madras Presidency, and the result is a net average annual return of 70 per cent., the average being taken from the year of the execution of the works, so that the returns at the present time must be at least 100 per cent.; this is the average

of all the works, including the few failures. But this is exclusive of the increase in the indirect taxes, for of course the improved condition of the people causes an increase of taxes on all articles paying duty. So that the actual return in *revenue* to Government at this moment must be much more than 100 per cent. To this is to be added the increase in the value of private landed property, which much exceeds that of the revenue, so that at the very least we are certain that these works now return on an average 200 per cent. on their cost. The increase in the saleable value of the lands in Tanjore, is shown in the fact that, since the great works there were executed in 1836, 700,000 acres of irrigated land are now sold on an average at least 20 rupees an acre more than before, showing an increase of capital of 1½ millions. Results such as these were calculated to awaken attention to the real nature and importance of expenditure upon works of irrigation. But so far from their having had this effect, we find in the papers laid before Parliament, that whilst an improvement which has taken place of late years in the land revenue of Madras is noticed with complacency, no attempt is made to ascertain the cause of the increase. This is a grave omission, for if it should have been proved that the land revenue of that presidency improves, or declines, just in proportion, as public works are neglected or promoted, a

conviction might have been forced upon us, that the sure way of equalizing revenue and charge, is by increasing our income. Expenditure is a Hydra which we have in vain attempted to put down. In India, the only way of counteracting its excesses, is by creating fresh revenue, and we have shown how this is to be done. But we shall never attempt to do this so long as we are guilty of the absurdity of clubbing money spent for securing and improving revenue, with expenditure which produces no such results, and placing both in the public accounts in the same category of charges.

To set down an expenditure upon works of irrigation which are to yield a return of 70 per cent., as a charge upon revenue, is calculated to check the outlay upon such works. To economize in the management of the revenue is financial wisdom, but to stint expenditure which has increase of revenue for its direct object, is financial foolishness. We may well mourn over a non-productive expenditure, and do our best to curtail it; but to bewail outgoings which are to bring us in large returns, is as if the farmer should grudge the expense of the seed-grain which he is putting into the ground.

The fact that in one solitary district, Tanjore, a system of moderate but actual improvement had been steadily pursued for fifty years, with the most extraordinary and unvarying success, by which the revenue had been increased from 32 to 52 lacs a

year, while the saleable value of the land had equally advanced, till it is now (allowing for the difference in the value of money) equal to the value of land in England, and that this had been accomplished without any sudden extensive outlay of capital producing a temporary difficulty, but by an average annual expenditure of about 40,000 rupees, besides the current expenses for the repair of existing works, is of itself sufficient to disabuse us of such false conclusions. The total sum so expended is about 20 lacs, and the increase of revenue per annum is the same; the increase in the value of private landed property is also about 3 or 3½ crores, indicating an addition of private income of 18 or 20 lacs a year. This money was expended in embanking the rivers; cutting channels for the distribution of water and for drainage; constructing weirs, sluices, aqueducts and other masonry works connected with the irrigation and drainage; in building many hundred bridges, and making 1,000 miles of common road for facilitating transit. This one district, standing alone amidst all the districts of India, shows what is the cause that there is yet no equalization of income and expenditure. All the districts around it have remained almost or quite stationary, excepting in so far as they have, though in a minor degree, had similar advantages granted to them. And still the expenditure in Tanjore has been so inadequate that the whole of its immense traffic is carried by common

roads; had a system of canals been added to the other works, it would have probably been benefited to the extent of another 20 lacs a year.

And if this improvement takes place in a single isolated district, what would it be if improvement were general, so that each district could send the produce it could best cultivate to distant markets, and obtain from distant places such things as it could only produce for itself at increased cost? It must be allowed that Tanjore has benefited very greatly by one improvement beyond its own limits, viz., the opening of the Paumbam Pass between Ceylon and the Peninsula, enabling it to send its produce to Columbo at one-third of the expense that it could before, and producing a saving in freight on its 70,000 tons of exported rice of more than four lacs a year. This shows how necessary it is to carry on these improvements generally, and how every district is interested in those executed in others. The sole reason why England has been paying millions a year to America for its cotton, wheat, and rice, instead of to India, and that the former has had a monopoly of them, is that public works have been carried on there whilst they have been neglected in India. And so long as India has its produce raised by a population liable to scarcity and famine, carried over hundreds of miles at a cost of *3d.* or *4d.* a ton per mile (equal, from the greater value of money, to 1*s.* 6*d.* or 2*s.* in England), and shipped at ports without shelter for

shipping, or depth of water for boats to land cargo, though all the wisdom of England were consumed in devising *modes of collecting the revenue,* and of reducing the expenditure, the "equalization of our income and expenditure" would be as far off one hundred years hence as it is now. While, if we promote the Tanjore system, and enable the rest of India to pay two-thirds more revenue than it now does, with an equal increase of private property besides, the question will be how to apply a surplus, instead of how to make up a deficit.

How strange it seems, that it should be necessary to argue all this again and again. At present, two persons out of every four are employed in growing food, and a third in carrying goods; one would suppose that it would be very obvious, that if by means of irrigation or other means, one person could grow the food for the four, and if by means of cheap transit, one person could carry for forty instead of for four, leaving nine-tenths, instead of only one, out of every four at liberty to labour, either in providing luxuries for the four, or in producing things for sale to foreign states, the worth of the country and its ability to pay an increased revenue would be enormously increased. Nobody can deny that by means of irrigation, &c., one person can grow as much food as two do now, or that, by means of improved transit, the same labourer would convey ten times as much goods as is required with the

present means; nor can it be denied that these advantages can be obtained at an outlay which would provide many times its interest, for all these points have already been proved again and again by actual results.

That money is forthcoming for such works is proved from the fact, that on the 30th April, 1852, according to the accounts submitted to Parliament, there was no less a sum than 13½ crores—upwards of 13 millions,—lying in the different treasuries unemployed, and the Government of India was urged to apply this surplus to the liquidation of debt.*

It thus appears after all, that not only is it in the power of the Government to obtain money for the purpose of throwing open India, and relieving it from an annual expense of several millions sterling, which is now actually incurred in the conveyance of goods across the unimproved face of the country; but that, even supposing that no better system of management could be arranged than one which requires the enormous sum of 7½ millions sterling to be always in hand to meet current expenses, there are six millions sterling now actually lying totally useless in the treasuries, quite sufficient to give 20,000 miles of lines of transit, at a rate certainly not exceeding one-tenth of what it is at present. Is it wise, then, to return money borrowed at four and five per cent., when, by employing it, you may obtain returns from twenty-five to seventy-five?

* Commons Report, Appendix xi. xii. pp. 338, 480.

We are quite alive to the fact, that England without her public works, machinery, roads, canals, railways, ports, steam and water power, and all those other appliances which enable the human power of the community to accomplish so much, could not pay a revenue of 50 millions; and yet we refuse to believe that the same causes will produce the same results in India, although we have instances of common roads, of canals, of irrigation works, &c., before us, which produce an annual relief to the country of more than cent. per cent. upon the outlay; and as money enough can be obtained at five per cent. to make every sort of improvement in India, the practicability of executing these essential works is undeniable.

The western road from Madras, constructed by Lord Elphinstone, cost about 10,000 rupees a mile (with a great waste of money), and the rate of transit has been reduced from 4¼ annas per ton per mile to 1¼ annas; and as there are now about 300 tons a day carried along it (besides travellers), there is a saving to the country from this work, of 18,500 rupees a mile, or nearly 200 per cent.; and had a canal been cut on the same line for 20,000 rupees a mile, probably the traffic would have been increased five-fold, or the cost would have been reduced to one-thirtieth of what it is now. Again, Cochrane's canal, about 10 miles of communication, costing perhaps 30,000 rupees, yields 30,000 rupees a year,

or 100 per cent. to Government, besides the saving to the community. Again, the opening of the Paumbam Pass,* which has cost about 2½ lacs, has reduced the cost of freight between Tanjore and Ceylon to one-third, producing a saving in the carriage of grain alone of more than four lacs a year, or 160 per cent., besides the reduction of interest and insurance from a shorter and safer voyage. Again, *all* the hydraulic works that have been executed in Madras in the last 14 years (omitting the Godavery works), which cost 5,40,000 rupees, have yielded on an average a net return to Government of 3,70,000, or nearly 70 per cent. per annum, on an average, from the time of their construction, and they are yielding at least 100 per cent. now, besides all the profit to private individuals. These are specimens of the effects of public works in India. How can it be otherwise? Does not common sense tell us that in a country almost in its natural state, occupied by millions of orderly and industrious people, there must necessarily be openings for the employment of capital in the improvement of natural advantages, far beyond what can be expected either in a country like England, where all the most obvious openings have

* This valuable work was accomplished by the indomitable perseverance and energy of my friend General Monteith, of the Madras Engineers.

already been taken advantage of, or in one like America, where there is a deficient population?

It is a common opinion, that if public works are executed at all, they must be done out of the current revenue; and further, that there is no other way of relieving the country than by paying off the debt already existing. With respect to the first, nothing can be more irrational or unjust. It is in the first place nothing more or less than the man's determination not to go into the water till he can swim. Till these works are executed, the revenue cannot seriously improve, and therefore if we wait for a surplus we must wait for ever. And what can be more unjust, if it were possible, than to grind out of the present generation the whole cost of works in which they only have a life interest? If the capital required for the works is only worth five per cent., this is all that can justly be demanded of the present generation, and not one rupee more should be demanded of them. Let future generations who succeed to the possession of the works, pay their share of the cost, by meeting the current demand for interest. Even if there were a surplus revenue, both common sense and justice show us that the taxes should be reduced, and not that this surplus should be spent on public works of this very remunerative character.

With respect to the notion, that there is no way of relieving the country but by paying off the debt, let us suppose that we met a poor famished

coolie fainting under a load of 20lbs., from want of food, and we have it in our power either to carry his load for him, or by feeding him, restore him to his full strength, and enable him to carry 80 lbs. with ease; which would be the best thing to do for him? Even if we were to take off the whole of the taxes of India, it would still be in a miserable state without irrigation, communication, ports, &c. And to increase its income by 25 millions sterling by means of these, would be an incomparably greater benefit to it than to take off the present 25 millions of taxes. A complete system of communication throughout India would undoubtedly increase the income of the country by far more than 25 millions a year. Let us take again the case of Tanjore; suppose, instead of spending 40,000 rupees a year on improvements, the same amount of taxes had been remitted, it would have had 40,000 rupees a year less to pay, but it would have been without those works which have raised the value of its land 3 or 3½ crores, indicating an increase of income of 18 or 20 lacks a year. Ask a sick man which he would rather a doctor would do for him, relieve him from a small part of his work, or restore him to his full health, so that his labour would be a pleasure to him; can there be any question which he would prefer? The present debt of India is utterly insignificant to a fertile country containing 100 millions of people in a state of perfect peace, if only they had the means

of transit. It only amounts to half a rupee per head per annum. The improvement in the revenue of Tanjore alone pays one-tenth of the interest, trifling as the works are that have been executed there, and the increase of private property there is equal to more than another tenth; if five districts out of the ninety or one hundred were thus positively improved, it would be equal to the whole interest of the debt.

The debt, whether incurred for wars, entailing a permanent charge upon the country without anything to balance it, or for the execution of public works yielding 100 per cent., or 20 times the interest, is equally called a burthen; and both are treated alike, and the same reasoning is applied to both, though one is the load on a bullock's back, and the other the wings of a bird, which instead of being a burthen, carry the body. We may safely say that there is an almost unlimited field for the employment of capital in India that will yield on the lowest calculation 50 per cent. to the community, so that every million borrowed and spent, will in the present rate of interest (four per cent.) be equivalent to paying off 11½ millions of debt; this is all the burthen it will be to the country. A burthen is not an absolute, but a relative thing; the present debt of India is a greater burthen to it with its 100 millions of inhabitants, than ten times the amount is to England with a quarter of that number of people, because it is starved to death and has no strength to bear even

so trifling a burthen. A million of people in Berar are paying annually 200 or 300 lacs a year for rice which they grow themselves, while they could obtain it from Rajamundry for 50 or 70 lacs if the Godavery navigation were opened; no wonder they cannot bear the burthen of these taxes when they have to bear this load of 150 or 200 lacs unnecessarily. If they could get their food so cheap from Rajamundry, they might employ their labourers in growing cotton for Manchester. And so also with respect to the sums actually paid for transit. The city of Madras, for instance, pays at least 12 lacs a year for the carriage of firewood, &c. or perhaps 20 lacs, 19-20ths of which might be saved by improved communications. With this load, equivalent to two or three rupees a head more than ten times as much as their share of the interest of the Indian debt, no wonder they are not able to bear the load of the taxes, light as they really are.

If we take the whole loss to India from want of communication at only 25 millions sterling, it is twelve times as great a burthen as the interest of the debt. How is it that there are such endless discussions about relieving it from the debt, and not one word about getting rid of a load in comparison with which the debt is trifling? How much easier will it be to increase its strength so that the debt shall be scarcely any burthen to it, than to get rid of the debt; and how much better to have a country in

health and strength, with a light load to carry, than a miserable, sickly, and starved one, though without a load, even supposing it were possible to get rid of the burthen, which it certainly is not, excepting by this one means of public works. India has been dealt with as an ignorant doctor would treat his patient, who persisted in physicking him to cure him of some complaint connected with the unwholesome state of his room, and so only reduced his strength more and more, while if he would give him a change of air, his system would gather strength to throw off the disease of itself. India requires something to invigorate the system ; it wants to have the light and air let into it by means of communications. If this were tried, it could soon throw off its present debt.

Whether England is to be dependent on America alone for cotton and cheap bread, or whether it is to have two strings to its bow, two customers for its custom, is the question. *India can supply it fully, abundantly, cheaply, with its two essentials, flour and cotton*, and nothing whatever prevents its doing so but the want of public works. If only the country is by means of irrigation supplied abundantly and cheaply with food, and by means of communications its produce can be cheaply conveyed to the coast, Manchester is safe ; its supply with the two things upon which its very existence depends cannot fail. But while three-fourths of the people of India are

raising food, and an eighth are carrying their produce over the unimproved face of the country at a cost that would instantly paralyze England if it were subjected to such an incubus, this magnificent appendage to England must be comparatively thrown away upon her, and the prodigious, the incalculable stimulus that it might give to her manufacturing and general prosperity must be in a great measure lost. 6476

Suppose all the rest of India had been treated only as Tanjore has been, what could have prevented the same results following universally,—the population doubled, the revenue increased 70 per cent., the private property quadrupled? And suppose that, in addition to the poor imperfect works that have been given to Tanjore in a long course of years (half a century), all India, as fast as it was acquired, had been boldly supplied with the works which are indispensable to a state of life and prosperity; suppose, by giving it communications, it had been relieved from a burthen equal to the whole present taxation of the country, and at the same time provided with that powerful stimulus which free intercourse would supply, who cannot see that the addition of such a source of supply for England's manufactures, and such a market for her goods, would have placed it in such a position of power and independence as cannot be estimated? How coolly we talk of 100,000,000 of people,—how little we think what such a population would be when roused from their torpor and

despondency, brought into a state of life and activity, and united under one intelligent government.

But before any such desirable results can be obtained, we must fairly get rid of the notion that the primary object for our consideration is the mode of settling and collecting the land revenue. We find undue prominence given to this subject in Mr. Campbell's work on modern India. It is not the education,—not the securing the supply of food,—not the power of transferring the products of their labour from where it is worthless to where it is valuable,—not the free intercourse of the inhabitants,—not even the knowledge of that only religion in which the true principles of right and wrong are found,—not in them or any other separate things, nor in all of them together, that the well-being of India depends, but in this one grand root of all good and evil, happiness and misery, wealth and poverty, safety and danger — *the mode of collecting the land revenue.*

Mr. Campbell states that the "magistrate and collector is a sort of local governor." Certainly, if he is not so, if he is not the representative of Government in his district in all its capacities excepting the judicial, there is nobody else whose business it is to attend to the various interests and wants of a community such as that of India, which to its present rulers is just like children in a nursery to their grown-up guardians. What we don't do for them they cannot do for themselves. Besides, then,

his magisterial duties, he is not merely the *collector*, but the person who should, in the fullest sense of the word, superintend the district. His business should be to attend to everything upon which the well-being of the people depends, excepting, of course, judicial matters. If it be said, "No, this is never intended; he is solely to *collect the revenue*, as the judge is to investigate crime," then it is allowed that the Government beholds with perfect indifference everything which is the source of evil or of good in the country, its sole duty, after securing peace, being to hang criminals, and pay itself for doing so. But this is totally contrary to all that is said; theoretically, the Government is generally acknowledged to have the whole welfare of the people in its keeping. But even supposing its sole business be to pay itself for keeping peace and hanging criminals, it is still a complete mistake to suppose that it has only to *collect*, and that the people, without any aid from it, will procure the means of paying the taxes. If a thousandth part of the time and labour that is expended on adjusting and *collecting* the revenue were bestowed upon the means which would enable the people easily to pay it, the Government would be rolling in wealth.

Supposing the ultimate end and object of the Government to be simply to obtain a certain amount of revenue, and that amount is the sole test of whatever is done, can anything be conceived more mis-

taken than to take it for granted that these results are simply the effects of a certain mode of *collecting the revenue?* Mr. Campbell takes the general collections of all Madras, and gathers from them the effects of the ryotwar system. In that set of districts are some that have, upon the whole, made at times, or throughout our rule, steady progress, — some that are now in a most wretched state,—some that had sunk excessively low, but are now in a considerable degree restored, without the least reference to the kind of settlement in them. But can any one suppose for a moment, who thinks at all on the matter, that there are not more powerful agencies at work than the *mode of collecting the revenue*, even in respect of the amount of that revenue? Many other things are undoubtedly of incalculably more importance than this one, and among them the construction of works for securing and improving the revenue.

Let us now suppose a district under this so-called wretched ryotwar management, in which every miserable victim is condemned to hold his own land, whether much or little, independent of all his neighbours, and enabled to do whatever he pleases with it, without any other ryot having the right to interfere with him,—a thing which would in England be considered an advantage,—but in this extraordinary country is, it seems, the greatest misfortune under which a man can labour. Let us suppose this district, though possessing a fertile soil and partial

supplies of water, to be yet in a great measure liable to lose its crops from the irregularity of the seasons, —sometimes from floods, sometimes from drought; and also suppose it to be without any means of transporting its produce during the principal part of the year, from the soil being alluvial, and the rivers unbridged. Government, on taking possession of this district, begin to expend on it a sum of money annually in such a way, either by keeping off the floods, leading water to new portions of it, or opening communications, as to make it yield a return in all of 200 per cent. We will suppose that 30 lacs is the revenue at first, and that 40,000 rupees are laid out annually on improvements (besides a like amount which is necessary to preserve the ground already gained), and that by that means a progressive increase of *income* of 80,000 rupees a year is obtained in the district. Let us suppose this continued for fifty years, making a total increase of *income* of 40 lacs a year. The *revenue* taken from the district has increased to 50 lacs; and as it is actually counted into the treasury, there is no question about that. The remaining 20 lacs of income retained by the people is shown by the saleable value of the land having increased by 300 or 400 lacs of rupees, yielding interest to the proprietors at five or six per cent. One of the ways in which this return for outlay has been obtained, is by leading 7,500 cubic yards of water to an acre of land at a cost of five rupees

of capital, by which an increase of produce over the former value is obtained to the extent of 10 rupees a year. Another is by laying out 1,000 rupees on a mile of road, by means of which 50 tons of goods per day are conveyed all the year round, at one anna less per ton per mile than they could previously be carried in the dry season only, being a saving of 1,000 rupees a year, besides the gain by being able to convey the goods in the wet season. Let us suppose the district thus provided with 1,000 miles of road, causing a saving of 10 lacs a year on this item of transit alone.

Besides these ordinary advantages let us suppose that this district, once in twenty or thirty years, when the whole Carnatic is deprived of its usual local rains, were in consequence of the care that has been taken to provide it with water, instead of sharing in the general calamity, and having to import half its food at a high price, enabled to sell nearly half its own produce, at enormous prices, to all the surrounding districts, thus nearly doubling its income for that year.

This, which is a correct statement of what has been done in Tanjore, will enable any person to understand how, even under a wretched ryotwar system, a district may stand Mr. Campbell's test, and show a very comfortable increase of revenue; such an improvement as, if it extended over five districts only, would have met the average balance against us of one million a year for the last thirty years.

On the other hand, let us suppose another district under a zemindary and village settlement, from which almost every farthing that is collected (besides what is expended on the collection), is sent out of the district; the old and partial means of securing it a supply of food left to go to ruin, and not a mile of road made in it; not a reservoir of water constructed, not an embankment thrown up, to prevent the river drowning any extent of crop, not a stream bridged, so that almost all its produce, except what can be consumed in the village where it grew, is utterly valueless; besides this ordinary state of things, let us suppose a failure of local rains to occur, which, in consequence of its being unmitigated by a single tank of water, which borders the district for 80 miles, or a single channel leading water from an unfailing river, produces the utmost horrors of famine, sweeping off fully half of the population, and reducing the revenue at once by 14 lacs a year, which is not fully recovered for twelve years. Now, this is a correct statement of the progress of Guntoor. Does any body find it hard to understand how any kind of *settlement* would have failed to make this a flourishing district? Let any gentleman in England manage two estates in this way. Let him manage one ryotwar; let it out to a number of small and large farmers independently, expending a portion of the rent every year upon it in such a manner as to make it more productive to the extent

of 2½ per cent. than its previous produce, while he only raised the rent 1¼; and let him manage the other by giving all his tenants a joint lease of it, but take the whole rent, without expending one farthing on repairs or improvements; let him continue this for fifty years, and suppose him then taking his friend to see the *results of his two modes of settlement* with his tenants.

Now let us suppose, in the case of Tanjore, that instead of the petty trifling way in which it has been improved, a really intelligent and vigorous system had been pursued. Suppose, for instance, that instead of 40,000 rupees a year, even one lac only had been spent in the irrigation improvements, so that the district had been brought into tolerable order, in that respect, in twenty years instead of fifty, and that, by continuing the expenditure, water had been stored so as to supply it throughout the dry season, instead of having it, as now, without water for four months, so that it might have grown sugar and other valuable products instead of rice only; and thus, that long before this, the district might have been exporting 100,000 tons of sugar a year, worth 200 lacs, besides various other things. Let us suppose, further, that instead of merely, in the course of the last thirty years of the fifty, constructing very imperfect unmetalled roads, worked at three annas per ton per mile, they had from the first commenced a system of steam canals, by which the

transit could have been carried on at half a pice, or one-sixteenth of a penny per ton per mile. At present there are just 1,000 miles of road in the district; if the average traffic is equal to fifty tons of goods a day, the daily cost must be 9,000 rupees, or 32 lacs a year. The steam canals providing for the great bulk of this would have relieved the district from an expenditure of 25 lacs a year on the goods and passengers now moved; besides, probably, at least an equal sum gained in the additional value given to goods which are not moved at all at the present high rates. With these additional helps, an additional income in more valuable products of at least 100 lacs, and advantages in the transit worth 50 lacs a year, the revenue might now be 100 lacs instead of 50, and the net income of the people also 100 lacs more than it is at present. And all this might have been done without a rupee being paid out of the general treasury; the district would itself have paid for all these improvements, from year to year, out of the additional revenue it would have been yielding, just as of late in the Rajahmundry district, where, while 20 lacs has been spent in eight years, 30 lacs of additional revenue have been received. No reason whatever can be assigned why this should not have been done; and thus, this one district, instead of paying 200,000*l.* a year in mere revenue towards the late annual deficit of a million, might have paid 700,000*l.*, or seven-tenths of the

whole deficit; and two districts, so improved, would have made the difference of our having for the last thirty years a surplus revenue upon all India of half a million, instead of a deficit of a million. And I think we may venture to say, this would have been the case under that revenue system which is the worst in India, according to Mr. Campbell, that is, even if every landowner had been compelled to manage his own land in his own way, and without the interference of his neighbours.

Is it not astonishing that sensible men could be so blinded, as to imagine that everything depended upon the *mode of collection of the land revenue* throughout India? When a district that pays 20 lacs a year in revenue, is paying the same for transit, or want of transit, who cannot see that there is at least one thing of more importance than "the settlement." I only bring forward this point of public works, because it is one that I am familiar with, but it is only one of many things, all of which are of a hundred times more importance than "the settlement?" Take, for instance, education. Suppose some "collector" had taken it into his head, that an intelligent and instructed million of people would be better off in every way than a million of people raised very little above the beasts, in fact, as entirely without anything that can properly be called knowledge, as their bullocks; and that, under this idea, he had everywhere established schools,

where all fundamental knowledge could be acquired in the vernacular languages,—what would be the state of his district by the time a generation had grown up? Suppose, further, that he had been so fanciful as to think that it might even be of some use to them to know the true principles of right and wrong, of truth and falsehood, and that he had had them instructed in the only religion where they were to be found, so that, instead of falsehood being almost invariable, and truth scarcely known, his district had been brought up to the standard of England, and that when a judge entered upon a trial, he could put himself upon this ground, that it was ten to one the evidence he heard was true; suppose a district in such a state as this, then might not the condition of the people be a little better upon the whole, even under a miserable ryotwar settlement, like that which England groans under, than under a village settlement, but without knowledge or right principles?

Nothing can be plainer, than that it is quite possible not only for an individual but for a whole body thus to have their attention so fixed upon some comparatively insignificant point, as altogether to lose sight of a hundred other things of incalculably greater importance.

Is India at this moment in an Asiatic or a European condition? How much of our time and attention is employed on matters calculated to

raise physically and mentally the state of the people?

Do we think that the welfare of the people depends upon their having right principles or knowledge, books, means of intercourse, division of labour, power of exchanging commodities, whether the whole community is employed in growing food, or only a small portion of it, while the rest are set at liberty to prosecute arts, sciences, learning, &c.? No; the great, the leading question is, "How is the payment of the land tax arranged?" Even whether, by facilitating the production and transfer of food and manufactures, the *income* of the *district* is increased tenfold, that is, whether the revenue drawn is one-fourth or one-fortieth of the *income*, is a matter of no moment compared with the *mode of collecting.* Yet we are Englishmen, and know that the foundation of all our national prosperity and strength is, that in consequence of the enormous economy of human labour by means of public works, only a few are actually employed in providing the mere necessaries of life, food, clothing, and shelter, leaving the great mass of the people at liberty to pursue learning, the arts, &c.

Till this insane idea, that the one thing needful is the revenue settlement, is given up, nothing can be done. Till our attention is turned to the source of income, and the circumstances of the people are improved, we shall be met at every step, as we have

been hitherto, with the invariable answer, "We can't afford it." Till then, there can be no education, or anything which can really elevate the people. The very first and fundamental thing is, by means of public works to increase the income of the country. This is within our reach. Any amount of money can be obtained from without for the execution of improvements, which will pay ten or twenty times the interest of the capital. There is not a shadow of ground for delaying those things one day, and they will naturally place at the disposal of Government funds for every other purpose. If the increase of revenue in Tanjore were not all carried off to supply the deficiencies of the districts which have been utterly neglected, there would be abundance of means there for every purpose. If it paid only its share of the current deficit (in addition to its original revenue of 30 lacs), which may be taken at one per cent. on a million sterling, or one lac, there would remain 19 lacs available. Nine of these might be at once given up to the people, by abolishing such items of taxation as are most injurious, and ten would remain for education, and such other things as could not yield a direct return in money. At the same time, all sorts of works which could conveniently provide a direct income to cover interest, should be carried on without stint by borrowed capital. For instance, a canal could be cut through the district, capable of bearing steamers of 300 tons,

and extended to Madras and to the Western coast, thus throwing the district open to both home and foreign trade. Such a work, if executed for 20,000 rupees a mile, would produce a saving of at least 30,000 rupees a mile per annum (2,40,000 tons at 2 annas), and hence, after paying 1,000 rupees as interest, would improve the income of the district by 29,000 rupees a year for each mile, or 20 lacs a year on one main line. The great mass of its trade being thus provided for, so that it could be carried at an almost nominal price, it would soon afford to have high-speed travelling and conveyance of valuable goods, as in England. Another portion of capital might be borrowed for the purpose of providing water by storing it in reservoirs for the summer irrigation, and so on. The district thus enriched, its income increased from 200 lacs a year to 300 or 400, and its revenue from 40 to 50 lacs, what would become of the great question, the mode of collecting the land revenue? This would be found to be easily settled when the amount was 10 per cent. of the income, instead of 30 or 40.*

* This district (Tanjore) affords a curious comment on the endless discussions about "the settlement." For twenty years, one-half of it has been settled ryotwar, and the other half mowzawar, and there is no difference to signify between the condition of the two. The same is the case also in two divisions of Mysore. In Nuggur, the old native system was almost entirely abrogated when the country came under British administration; the

Mr. Campbell, in his more recent work, "India as it may be," proposes to extricate us from our financial embarrassments by taking a million of territory from the king of Oude, and by reducing the military expenditure by two millions; but all experience teaches us, that the mere extension of territory is the sure cause of increased debt. What we want, therefore, is not increased territory, but improved territory. What we want to know is how we may improve the sources of our revenue. Those sources are comparatively unproductive because the people are poor. Why are the people of India poor? Because, being entirely without any means (excepting bullocks) which can be substituted for human labour, it is as much as they can do to feed, clothe, and shelter themselves; or rather I should say, *more* than they can do, at least while they have to keep their rulers in luxury. This is the plain indisputable answer to the question. Why is England rich? that is, why has it the means of supplying itself with a thousand things beyond the mere necessaries of life? Because, while it contains only 25 millions of

ryotwar system was introduced, and other changes of the same sort made. In Chittledroog, the old village system, with division of the crop, &c., was continued. In both, the revenue has increased very much, and quite as much in the latter as in the former. The improvement is attributable chiefly to, 1st, steady and honest government; 2nd, European superintendence; and 3rd, care of roads, tanks, &c.

people, there is as much done by the aid of steam, water, roads, canals, railways, ports, docks, &c., as could be effected by the labour of perhaps 200 millions of people; and having therefore the work of that number, while the necessaries of life are required for only one-eighth, there is of course an enormous surplus for other things. And this is not peculiar to one country, for if, besides the labour of 140 millions in India, we had the work of another 500 millions performed by roads, canals, railways, water, steam, &c., there would be in India also abundance of labour available for other things beyond the necessaries of life.

Now where is the difficulty? Thousands want to lend money at four per cent., thousands of Europeans and natives want employment as superintendents of works, &c.; thousands of iron manufacturers and others in England want a sale for their goods; lacs of people in India want employment as labourers and artificers; millions of ryots want water for millions of acres; tens of thousands of miles of communication, and the means of carrying produce, need to be constructed: and thus millions might be expended so as to yield ten, twenty, or fifty times the interest paid for them. Everything is ready except one thing. But there is indeed a difficulty, *the* difficulty which has kept India immersed in ignorance and poverty from the day we commenced our rule up to this day. It is this, that Englishmen,

instead of coming to India to teach the natives the things which make us what we are, sit down to learn of the natives the things that make them what they are. How wonderful it is that the man, who if he was in England would be certainly engaged in furthering everything in which England glories, should in India occupy himself from morning to night with this notable subject—the settlement of the land revenue of his district. He sees, for instance, that his district is paying 10 or 20 lacs a year for the transit of goods, and that it cannot find a sale for what it produces for want of the means of sending it to places where saleable; and yet he is completely at a loss as to what can be done to relieve and improve it. He turns again to the "settlement," and tries once more what he knows has been tried a thousand times before in vain, how to make a district, steeped in poverty, pay additional revenue without increasing its resources. He sees and hears of capital employed in almost every kind of public works, yielding 50 or 100 per cent.; he sees that his own district, in producing certain articles of food, clothing, &c., pays double or treble what they could be procured for from another part of the country, if there were but cheap transit; whilst other districts are wanting, and paying double or treble for things which could be got far more cheaply from his district, and yet he cannot think of anything to enrich his district, except giving a little more time to the "*settlement*," or

reading a few more thousand sheets of paper on that everlasting subject. Here is the real and the sole difficulty. To remove it, one word from our rulers is all that is required ; everything else is ready, and has long been ready. Let them only open a loan for 20 millions to begin with, order the expenditure of three lacs a year in every district, purchase a million tons of rails and such other things as can be got at once for money, and will help towards the improvement of the resources of the country, and the whole difficulty is got over. This might be done to-morrow; nothing is required but that what has been so well done by the Governor General about the telegraph be applied to everything else of this kind, that is, to say, "Let it be done."

I cannot but hope that these pages, which, though roughly and hastily written, are the fruit of thirty years' experience and active practical acquaintance with the subject of public works in India, and of constant contact with the natives in their villages, may, with God's blessing, be of use in stirring up England to consider this point. It may be said, these public works are very secondary matters. After providing for the protection of the country, the civil and judicial questions are the great things to be attended to. The question of public works is however in reality a fundamental point, for upon it and upon it alone depends the power of the country to supply funds for every purpose, both military and civil.

Without them the country must be sunk in poverty and ignorance, and funds cannot possibly be produced from the country itself to provide for anything which is necessary to elevate and improve the state of the people; with them the most abundant funds can be obtained for any purpose. We have now proofs of the effects of capital expended in almost every kind of public work. The Paumbum Pass, between Ceylon and the Peninsula has been deepened from 5 to 10½ feet, and it has reduced the freight between Tanjore and Ceylon six rupees a ton, which on the 70,000 tons of grain alone, is more than four lacs, while it has cost 2½ lacs. It has also led to a complete change of the system of navigation, substituting good keeled vessels that can work to windward, for the old native tub that could only sail before the wind. This is a case of coast improvement. Tanjore has been irrigated and drained, and provided with common roads and bridges. About 20 lacs (besides repairs) have been expended on this in all, and the revenue and net income of the people have each increased to that amount *annually*. The western road from Madras cost about 12 lacs and the cost of transit on it has been reduced to one-third, producing a saving on 100,000 tons a year over 125 miles, or 15 or 20 lacs a year. The northern canal, which probably cost about 30,000 rupees, yields a revenue of 30,000 rupees, besides the saving to the community. A set of works for the improvement of

Rajahmundry are well advanced. They consist of a weir across the Godavery, with navigable and irrigating channels, &c. They have been in hand seven years; 20 lacs have been spent up to this time, including repairs, and the revenue has increased steadily from an average of 19 lacs to 25, giving a total increase of 30 lacs, against 20 expended; and this besides an enormous gain to the people. So that this vast system of works, which when completed will have cost 25 lacs, which, allowing for the difference in the value of money, is equal to 1½ millions sterling in England, has been carried on, not only without demanding a rupee from the general treasury, but with a clear surplus of 10 lacs of revenue, and this besides the vast benefits to near a million of people, and promising to yield, probably within a few years, a permanent increase of revenue of 10 or 20 lacs a year, for not a quarter of the land is yet fully watered. These are undeniable facts.

I should observe, that in all my calculations about returns I keep entirely separate the two questions,—what are the actual profits of a work, that is, to the community? and what may be the profit realized by the Government if they undertake a work? It is most essential that these things should be kept perfectly distinct. Our great question is not that of a speculator or company, but what will be the total benefits to the community? When we have formed some tolerable estimate of this, then we may proceed

to consider the second, that is, What proportion of those profits may it be possible and advisable to carry direct to the treasury? In many cases, it may be clearly advisable not to take any, but to trust to its indirect effects upon the revenue to pay the interest of the money expended upon it. This, I think, is clearly the policy with common roads and canals, leaving them entirely free, and the traffic burthened only with the bare cost of transit. Of course, it is clearly desirable, that when such a work is executed, the greatest possible use should be made of it, and the smallest toll, to say nothing of the evils of interference, necessarily prevents the transport of some things which would otherwise be carried upon it; and there are special and palpable evils connected with levying taxes on goods while in motion. A general principle of taxation should be to take duties only when goods are in store, or are being stored, when the owner has time to complain or appeal. In case of irrigation, on the other hand, when taxes are to be levied at all events, the additional tax causes no additional expense in collecting, or additional interference with the owner. In some cases, also, it may be advisable merely to take so much as to provide for the interest of the money, and in others, it may be a good opportunity to make the work a direct source of revenue to the state. The State of New York is doing this with the Erie canal; but I

must think this a very questionable policy in the case of a canal.

There is also a question as to the policy of levying a toll for the purpose of reducing the debt on the work. This, I think, might perhaps be advisable where tolls are levied at all. For instance, if 4 per cent. is the interest of money, by levying tolls which would amount to 5 per cent., the principal would be paid off in about thirty-five years. In works which would yield such enormous benefits as most of these in India, it would form no very heavy charge upon them if sufficient were levied to pay off the capital in ten or fifteen years.

One of the most important points to be kept in view in these matters is this:—in a country so much in want of capital as India, the real cost of a work to the Government is very far indeed from being equal to the amount expended on it. It is impossible for the Government to spend a lac of rupees in a district without the revenue immediately feeling the effect of the expenditure to a great extent; so much so, that I am very much inclined to think, from what I have seen, that such an expenditure is even at the very time little more than nominal, so far as it is spent on the spot. The people generally, and especially the ryots, are so paralyzed from want of capital, that every rupee that comes into their hands enables them to do something which shall return

50 or even 500 per cent. in improving their cultivation; so that the effects of a lac of rupees spent on public works is, first, to find work for men who would otherwise be employed in the dry season to so little purpose, that their food is almost a dead burden to the community; and then, by providing purchasers for produce, to put it into the power of the ryot to extend his cultivation, and pay additional land-tax. On this account there would assuredly be an immediate and most sensible relief to the finances by the mere expenditure of 20 millions of borrowed capital in the country, quite independent of the direct returns.

The essential fundamental principles that, in my opinion, should be kept in view in the matter of public works for India are,—

1st. That on no account whatever should any money be spent upon them which is taken from the current revenue, as being quite contrary to every principle of reason and justice, to make the present generation pay the principal for works of which they have only a life use; and

2nd. That the account of all expenditure on public works should be kept entirely distinct from the general revenue accounts of the country.

Till these two principles are acknowledged and acted upon, I can see no hope for India. The current revenue never can provide money for great public works; to make the one wait for the former,

is to put the cart to draw the horse. The revenue can never produce the public works, and nothing but the public works can produce increase of revenue. But how wonderful it seems to have to put such things as this on paper. Is there a man in England that does not know that if they had waited there till the revenue had provided money for the public works, they would have waited till now? Out of the hundreds of millions that have been expended on roads, canals, and railroads, — on lighting and paving, and sewers,—on docks and harbours,—on lighthouses, and on a hundred other things, what per centage has been paid by the generation who executed them? Is not $\frac{99}{100}$ of all the capital expended on those works a debt to this day? And is it a burthen to the country? It is a burthen which adds 50 lbs. to the weight the country carries, and 50 lbs. to its strength. It is like the load that a traveller carries away when he stops at an inn and eats a pound or two of dinner; it does not hinder him much from carrying any other burthen he may have. In fact, it is John's public works that enable him to carry a national debt which would break the back of any one of his friends on the continent who have not got so much in their stomach. Ask Tanjore how she would like the bargain to be obliged to carry her own debt for public works, together with their profit, and to pay four per cent. on the 20 lacs they have cost (80,000 rupees a year), and do what she pleased

with the 20 lacs a year of additional revenue they have produced, and see if she would account it laying an additional burthen upon her. Call upon Rajahmundry to pay only her old revenue, but at the same time to pay the interest of the cost of her works. What can be the reason that principles that no man ever dreams of applying to England should be applied to India by all sorts of people?

For the second of the above two principles, as long as the salary of the Governor-General and the cost of a bridge or a canal are added together, what can there be but utter confusion! How can anybody tell what they are doing while such absurdities are committed! A bridge or a canal is just as much *bonâ fide* property as the rupees that paid for it; indeed much more so, for the latter, while they are hoarded up (as at present such millions are in the treasuries), are of no use to any living being. Imagine a man saying: "I was very rich once, I had 10,000*l.* in a box in my house, but now I am a beggar; I spent it all on this estate which yields me 1,000*l.* a year." The Governor-General's salary is money paid for advantages already consumed, and which will yield no permanent income to the State; at least, the same sum must continue to be paid every year. To treat all the public works executed by Government as no longer property, because not in the form of rupees, is preposterous. There should therefore be a Department of Public Works, which

should keep a complete and distinct set of accounts of its own. Everything spent by it should be divided under two heads,—1st, current expenditure on superintendence and necessary repairs; and this should be afterwards entered in the general accounts of the State as part of its current expenditure; and new works including improvements. A dead stock account should be kept to balance against capital sunk, and means should be taken to obtain a tolerable estimate of the actual total returns of all new works, so far as they could be ascertained and stated. And if, at the end of five years, it appeared from these accounts that 20 millions had been spent, and that there were 20 millions' worth of public works on hand, yielding in various ways, upon a reasonable estimate, 10 millions a year, we must not conclude that we were 20 millions poorer than we were, and weary ourselves to discover a way how we could get rid of this 20 millions of debt, but comfort ourselves with the thought that we were paying with one hand 800,000*l.* a year, and receiving with the other 10 millions. I am afraid people will say: "We don't require a book to tell us such things as these; they are not discoveries." But what is to be done? these things, which everybody knows, never appear either in the minds or deeds of the Government of India, and there seems no alternative but to bring them forward once more. Against the debt there is to be set something considerable even now,

notwithstanding the general neglect of public works, in the shape of property yielding abundant returns. Perhaps in the Tanjore and Rajahmundry, and other new irrigation works in Madras, in the Madras western road, in the grand trunk road, in the north-west canals and other works, a dead stock account, to the amount of two millions or more, might be made out. All this is *bonâ fide* property as much as the rupees that were spent on them, or rather much more. Perhaps, on an average, these two millions yield two millions annual profit to the community; and if so, they are equal in value to 50 millions of rupees, or nearly equal to the whole Indian debt. If these things are taken into consideration, as most undoubtedly they ought to be, they will give a totally new aspect to the state of Indian finance.

But we shall in vain hope for earnest action in this matter unless we shake off a peculiar disease, which is apt to take a deadly hold of us old Indians. We are apt to dwell with intense interest upon trifles, and to betray symptoms of disquiet if questions on which the lives and interests of millions are obtruded upon us. A question arises, who is to be made to pay for a few panes of glass broken in a barrack? and, for the settlement of it, a special committee—the Military Board, the Chief Engineer, the Governor in Council, the Court of Directors, the Board of Control—are all put in motion, and a mountain of correspondence is the result, which

costs fifty times as much money as the repair of the broken panes, and time that is inappreciable.

The abundant supply to England of good and cheap cotton, and the providing India with a market for its produce, to an amount far exceeding all her present exports put together, are vital questions to both countries; all that is wanted to produce these great results is, the expenditure of a small sum, in order to make the river Godavery navigable. Application is made for 500*l.* to enable the officers employed in the Godavery to examine the river by means of the Government boats there. The Madras Government get rid of the question by estimating the cost of the experiment at one rupee more than they have power to sanction, and send it to the Government of India with a letter which gives the least possible weight to the question. That Government replies in three lines, that it is matter of little importance, and that the present state of the finances of India will not admit of the expenditure; although, at that time, there were lying unemployed many millions of money. A great national question is thus easily strangled; whilst it takes a most elaborate apparatus, and months of deliberation, to determine who is to be amenable for the accidental fracture of a few panes of glass. To this sad disease, and to our unhappy habit of descending to the level of native ideas in all matters of Government, instead of imparting to the natives our

science and knowledge, we may trace most of our shortcomings.

Who can bear to go through the collectorates of India, and see their degraded state, and think what they ought to be after 50 or 100 years of the rule of the most free, enlightened, and powerful of all the nations of the earth, the only nation that is not effectually hampered in her own progress, either by a false religion, or by some form of slavery? What more can be necessary than to bring the influence of such a nation fairly to bear on the millions of India? What can have hitherto prevented the marks of her rule being seen in the instruction, liberation, and the enriching of people of India, except a system which has, in effect, warded off that influence, by asiaticising first all who (called Englishmen) were to have a hand in her nursing. Nothing is more certain, and more universally seen, than that all men, in a great measure, and some entirely, lose their individuality, and become an intrinsic part of that system with which they are mixed up. A Kentucky slave trader would have had as clear an abhorrence of slavery, if he had been in England from the age of eighteen to fifty, as any of us. And any old Indian would be as much startled as any other Englishman at the unchanged state of an Indian village or district, notwithstanding our rule, if he had never before been out of England. He would probably say, "What, are there no Christians here? Do you

not instruct them in any thing? Have you no roads, or any other communication? What in the world do you do? I do not see a single mark of an Englishman having been in the country." But, as a part of this system, all this appears to the Anglo-Indian the most natural thing in the world. "It is the way we do in India. In England, of course, we are quite different beings. There we never dream of discussing the mode of collecting the land revenue, but we take part in a thousand plans of improving our own and our neighbour's condition."

A new race of beings, a new system, a new set of ideas are required. Publicity, light and air, the immediate exposure of every public document connected with the ordinary business of Government for discussion, by young as well as old, these things are essential to such a change as India requires. And who cannot but hope that, in the providence of God, we are on the eve of a new start for India; that the present discussions will break up for ever the old decrepit system, and give rise to a fresh, healthy, vigorous one, worthy of our religion and of our nation.

CHAPTER II.

Extent of Communication—Present Cost of Transit, &c.

TAKING the area of India (including all between the ocean, the Himalayas and Afganistan) at a million and a quarter of square miles, we shall find that to open this tract up with main lines of communications, fifty miles apart, would require about 50,000 miles, besides all the minor roads, which if placed five miles apart, would be 500,000 miles in length. We may now try to frame a very rough estimate of the actual extent of communications, with the cost of transit by them.

	Land miles.	Rate per ton per mile.
1. The sea navigation from the mouth of the Indus to that of the Ganges .	3,500	8½ to 5 pice.
2. River navigation . . .	2,000	4 pice, or 0½*d*.
3. Complete roads . . .	2,000	1 anna, or 1½*d*.
4. Imperfectly made roads, perhaps	10,000	2 annas, or 3*d*.
5. Unimproved tracks . .		3 annas, or 4½*d*.
Total . . .	17,500	

Before we proceed further we must examine these prices, to see what proportion they bear to those of

England or America. The actual value of 1 anna is about 1½d., or 3 cents, reckoning the rupee at 2s. But we must allow first for the difference in the value of money. A pound of rice in India costs about 3 pice, or 1¾d., and that of the flour of other grains about ¼d., or 2 pice. Taking the cost of flour in England at 1½d., the value of money as shown by the value of food may be taken at six times as great in India as it is in England. And if we try it by the cost of labour, taking it in its simplest form, a cubic yard of earth may be dug and carried to a bank ten yards off for about ¾d., on an average in India, against about 6d. in England. And so with other kinds of labour. We shall be near enough for our present purpose if we take the value of money in India at six times what it is in England on an average. Over a great extent of country it is as much as eight to one. And probably it is fully ten times what it is in America, calculating from the rate of labour, but not more than perhaps five times by the cost of food, labour being better paid in America than either in India or England. We may therefore reckon the Indian rates of transit as equivalent in England to

	6d.	per ton	per mile	by sea.
	3½	do.	do.	by river.
	9	do.	do.	by good roads.
1s.	6	do.	do.	by imperfect roads.
2s.	7½	do.	do.	on unimproved tracks.

Is not this alone quite sufficient, without a word more, to account for the impoverished and backward state of India? The average of all the traffic of India cannot be less than 1*s.* per ton per mile, allowing for the difference in the value of money, while in England the average may probably be taken at $1\frac{1}{2}d.$, or one-eighth of that of India; it must indeed certainly be at least eight times as great in India as in England, taking it only mile for mile.

The following are some of the English rates:

Liverpool to Manchester	3*d.*	a mile	per ton,	railway.
London to Birmingham	$\frac{4}{5}d.$	,,	,,	canal.
Liverpool to Birmingham	1*s.* $1\frac{1}{3}d.$	,,	,,	railway.
Grimsby to Manchester	1*s.* 10*d.*	,,	,,	railway.

What would be the reduction in the traffic of England if the cost were suddenly increased eight fold? perhaps nine-tenths of it would be stopped.* But this calculation still does not give, by any means, a correct view of the case. We must compare also the comparative distances that goods must be carried in the two countries. In India, the extreme distance that goods must be carried to reach the port is 1,200 miles; in England it is about sixty miles. The average distance that exports and imports are carried in India may be 250 miles, in England it cannot exceed forty. We may safely

* In America the cost of traffic may be taken on the railways at $1\frac{1}{2}d.$ and on the river navigation at $\frac{1}{6}d.$, the average being considerably below that of England.

allow that in general, goods are carried six times as far in India, from the place of production to that of consumption or export, as they are in England; so that combining this with the cost, there is thirty-six times as heavy a charge upon transit here as in England. But there is yet a third consideration; the average value of the commodities moved in India is far below that of England. By far the greater proportion of all that is moved in India are coarse goods, raw produce, and such things, while in England a very large proportion is manufactured goods and other valuable articles. If, for instance, we take a ton of Berar cotton, the charge of transit, compared with its value, will be as follows:

Cost of one ton in Berar.	140 rs.
Do. of carriage 350 miles, to Bombay, at 3 ans. per mile.	66 ,,
	or 47 per cent.
Cost of do. at Liverpool at $4\frac{1}{2}d.$ a lb. .	£40.
Carriage of do. to Manchester, 30 miles at *3d.*	*7s. 6d.*
	or one per cent.

and in its manufactured state, the cost of transit would bear a still less proportion to its value. Again, we may take a ton of sugar, brought from the upper provinces to Calcutta.

Cost where produced.	120 rs.
Do. of transit to the coast by river. .	20 ,,
	or 17 per cent.

Value of do. in London, ... £40
Cost of conveying 50 miles, to place of consumption . . . . 8*s.*
or one per cent.

If we take the *average* value of goods conveyed in England, and compare it with that of India, we shall find that the per centage is higher than the highest of these.* We shall probably be safe in concluding that the cost of transit in India is equal to an *ad valorem* tax on the goods conveyed, fully fifty times that of England. We cannot form a correct judgment of the expense of the transit upon India as compared with that of other countries, without taking all these things into consideration. What would England be with such an incubus upon it as this tremendous transit tax in India ?

But the mere comparison of the rates per ton per mile must give a totally false idea of the state of the case unless we consider also the following things :—

1, The value of money ;
2, The distance carried ;
3, The value of goods ;
4, The time and risk.

Till this is understood and considered, there can

* And to all these we must still add the cost in time and risk ; supposing that cotton is two months travelling to Bombay, the interest at 12 per cent. per annum would be 2 per cent., and the insurance could not be less than 2 per cent.

be no hope of any serious effort being made to relieve India from a burthen compared with which the whole of the taxes received by Government are of little importance. How is it possible that India, notwithstanding its cheap labour, extent of rich land, powerful sun, and copious monsoons, can contend in the markets of the world with other nations, while weighed down by such a load? There can be no possible mistake on this point of its immense disadvantages in all other respects compared with other countries.

We may now try to form an estimate of the actual amount of this tax, as now paid in money. Our data for this are very imperfect, yet we may easily satisfy ourselves that it cannot be less than a certain sum. We may take first some well-established instances of the cost of traffic.

It has been estimated that the amount of inland traffic at Calcutta is 2,000,000 tons per annum. If we take the average between the North-West Provinces and that port at 1,200,000 tons, and the cost at 25 rupees a ton (four pice a ton per mile per 1,200 miles), the total cost on this line of transit will be 300 lacs a year for goods only. The rate is stated much higher than this in the railway pamphlets; but there are evident mistakes in them. The total cost, including interest and insurance, is there calculated at nine pice a ton per mile, which would give a total of 648 lacs, besides the sums paid

by passengers. If we allow 500 lacs, including everything, I think we shall be under the mark for the river expenses. If we suppose this two-million tons to be brought on an average fifty miles by land to the river at three annas per ton per mile, it will add 180 lacs to the above, making a total of 680 lacs, or nearly seven millions sterling, equal to one-fourth of the amount of the whole revenue of India, expended on this one line of transit.

We have an instance of the coasting trade in the case of the Paumbam Pass. The traffic through it is at present 148,000 tons, including empty vessels; perhaps 120,000 tons of freight, allowing for loaded vessels carrying more than their tonnage. This is mostly carried between Ceylon, or the western coast, and Tanjore or Madras, at about 10 rupees a ton, and therefore costs 12 lacs, besides interest and insurance, perhaps 20 lacs in all, on a distance of about 500 miles. The traffic on the western coast is far greater than this; and the cost of that of the whole 3,500 miles of coast round the peninsula cannot be less than 200 lacs.

Of the traffic by land, we have one instance in the great western road from Madras. The traffic on the first 125 miles of this is about 100,000 tons a year, at $1\frac{1}{4}$ anna per ton per mile, or in all 10 lacs, besides passengers, and interest, and insurance.

Allowing, then, 900 lacs for the Ganges and the coast traffic alone, besides all the vast land traffic of

the interior, we surely cannot over-estimate the sum actually paid in India for transit at 1,500 lacs, or 15 millions sterling; and hence, if the average cost of transit could be reduced to one-fifth of what it is at present, the country would be relieved of a direct tax of 12 millions sterling, equal to a diminution of the present taxes by one-half.

But this is only a small part of the effect of opening the country generally, and giving it cheap, safe, and expeditious transit. The great loss is not in what is paid for goods carried, but in what is never received,—things that are not carried. Of the immense traffic that there would be if the cost were diminished, we have the strongest proof in the Paumbam Pass, where, in consequence of the reduction of freight to one-third of what it was, and to the diminution of time and risk, it has actually increased nine-fold, though the cotton that used to pass through that channel is now shipped at the ports of Tinnevelly. What is the traffic of England now, compared with what it was before there were either canals, or railways, or even turnpike roads? It must certainly have increased a hundred-fold; and I have no doubt that it would increase in India in something like the same degree, particularly considering that the proportion of cost of transit to the value of the goods is, as I have shown above, so much greater than it ever was in England, on account of the much greater distances carried, as well as the

inferior value of the goods. There can be no doubt that a transit charge of 50 per cent. on the value of the goods must be a much greater check to traffic than one of five, and that, if it is reduced from 50 to 10, the increase of traffic will be much greater than when it is reduced from five to one. It is, in fact, absolutely incalculable what the traffic would increase to if goods could be moved at 100 miles a day for one pie a ton instead of ten miles a day for 1½ annas. But I have no doubt that, by due improvement of the rivers, a very large proportion of the traffic would be conveyed at one pie a ton per mile.

But this refers only to the loss in money from the expensive transit or non-transit of goods. Who can estimate the effect on the country by the hinderance to personal intercourse from the present state of things? What would be the state of England if the cost and time of passenger transit were increased tenfold? but if, also, there were no such things as relays of animals posted for conveyances throughout the country, so that if a man wanted to travel he must go by daily stages, as long only as the same animal could perform, and thus to go from London to Liverpool would take a man who could afford to ride seven days, as that distance would in India. In this country, if a man wants to go a moderate journey, such as 300 miles, he must be fifteen to thirty days about it, besides all the inconvenience of having to take people with him to cook his food,

or cook it himself, wherever he stops. This country is not in the state England was before there were railroads, or even turnpike-roads, because even then there were relays of animals throughout the country. How much intercourse would there be in England now, and how would business be carried on, if a merchant of London who wanted to go and see a manufacturer at Birmingham must be from home a week; or if he had to transact business with a Yorkshire clothier he must be absent a fortnight? It is impossible to conceive the amount of disadvantage under which India labours in this respect.

Yet, notwithstanding this, the passenger intercourse even now is surprisingly great. The general idea on the subject of travelling in India seems to be extraordinarily wrong; it is even often a question whether there would be any considerable number of passengers on the railroads. The fact is, that the number of travellers even now is exceedingly great.

The following are some of the ascertained numbers:—

	Adults per day.
On the high road from Negapatam to Tanjore, at a point 20 miles from a city in 1837 . .	1,200
On the bridge over the Colleroon, three miles from the town of Trichinopoly	19,000
From Calcutta towards the upper provinces .	1,500
On one of the main roads, 11 miles from Madras	3,000

From these instances, and from experience in the

country, there is no doubt that if there is *cheap* transit, even at the rate of 100 miles a day, there will be an immense passenger traffic on all the main lines. Between Negapatam and Trichinopoly, for instance, there can be no doubt that it would be quadrupled, or that there would be 5,000 travellers a day. On the great western road from Madras, also, as soon as the railway is extended to 150 or 200 miles, if the poor travellers are conveyed at a rate proportional to that in England, or suppose at one pie, or $\frac{1}{8}d.$ per mile, no doubt there would be several thousands a day.

Of the effect of free intercourse on the country, especially in weakening the system of caste (the great curse of India), who can fully judge? Of this we may be certain, that the country will make more real progress in everything that is desirable in ten years with such means of intercourse than in one hundred without them.

Returning, however, to that part of the subject which can be shown in figures, we see that, at the very least, we have to deal with a matter of 15 millions sterling a year in actual payments; and if we only allow that as much more is lost in these things which cannot be used, or cannot be produced because the cost of transit prevents their being used, it will show a loss to the country of 30 millions a year, or much more than the whole amount of the annual revenue; and could we relieve the country from five-

sixths of this, it would be at least equivalent to abolishing all taxes; but it would in fact be incalculably more beneficial, because there would be all the gain of the immense stimulus that would thus be given to industry and exertion. Of the hinderance to trade, by this stoppage of goods that might be carried, we may judge from this fact: that if a ton of any produce is carried 200 miles at three annas a mile, or a total cost of 37½ rupees, a trade of the extent of 100 tons a month would cost 3,750 rupees, or 4,500*l.* a year. So that if at present it were not worth moving, by reducing the cost of transit two-thirds, that article of trade would afford a merchant profit of 3,000*l.* a year. Again, the cost of carriage of cotton is often 8*l.* a ton, from the place of production to the shipping port, being ten times as much as would afford a merchant's profit on the goods. So that what cannot now be grown because there would be no profit on it, might, with cheap transit, afford a profit ten times as great as would be sufficient to produce a trade in it. By these considerations we see how it is that on every diminution of cost of transit the amount of traffic increases so surprisingly.

Again, if one part of the country is particularly favourable for the growth of some article of produce, the extension of it will depend, not only upon the cost of its transit when produced, but upon the cheapness with which food and other necessaries of

life can be brought to those who are employed in producing. Thus, in a good cotton district, at present they must grow their food on the spot, because the great cost of transit utterly precludes the conveyance of such a bulky thing as grain from any distance. But if this were reduced, the land peculiarly favourable for cotton would all be given up to that culture, and the food for the cultivators would be brought from where the cotton could not be grown so profitably. At present it costs $\frac{1}{8}d.$ a pound to convey rice 180 miles, thus doubling its cost; or the food of a man for a year, if conveyed that distance, would cost in carriage 10 rupees, or nearly one rupee a month, half a man's wages; but if the transit were reduced to one-fifth, or to one-twentieth, as it might be where there is water-carriage, it might be brought that distance for one anna a month, and thus in such soil and climate the produce most suited to it would be grown. How immense the traffic would thus become! Perhaps, for instance, the principal part of the agricultural population of Berar would be employed in growing cotton, while their food would be grown in the irrigated lands of the Delta of the Godavery. If only two millions of people were so provided with food, there would be a traffic up the Godavery, in food alone, of 700,000 tons a year.

Not a ton of any thing but timber is carried by the Godavery, though it is now navigable for at

least six months in the year. A comparatively moderate outlay would make it navigable throughout the year. If it were navigated, goods could be carried between the coast and Berar for from one to five rupees a ton, whereas the present difference of value of rice, cotton, salt, and wheat is, on an average, about 100 rupees a ton in the two places. The Berar people grow their own rice at four times the price they could get it for from Rajahmundry, and they also pay four times as much for salt, as they could get it for by the Godavery, while they have no sale at all for their wheat, and comparatively little for their cotton, because of the cost of transit to the coast. They could supply Manchester with cotton and wheat at 25 per cent. less than it pays to America for the same things, and if thus provided with a market for its staples, and relieved from the high cost of food and salt, it could afford to purchase the manufactures of Manchester, Birmingham, Yorkshire, and indeed of all parts of England. In this way, it is easy to see what immense traffic there may be in the country when the cost of transit is greatly reduced. And hence, we see how absurd all calculations are of the traffic on a proposed line of communication based entirely on the present amount. It is not that the traffic may be doubled or trebled, it may easily be increased ten or fifty fold. In fact, a reduction of cost of transit may produce any extent of traffic. A reduction of five

rupees a ton may make the difference of a trade in some vast and bulky staple where before not a ton was moved, and, consequently, it may cause a sale of goods to the extent of twenty times the amount saved in transit. The opening of the Godavery may, on the most moderate calculations, raise the sale of cotton and wheat grown in Berar to the amount of a million sterling, of rice and salt produced in Rajahmundry, to half that amount, and of English manufactured goods of the value of another half million. At present, only comparatively valuable things are moved, and the bulky things of small value, such as building materials, food, manure, &c., are scarcely moved at all. While the towns are polluted by the accumulation of filth, the fields are barren for want of it; and while the towns are without good building materials, the country is full of them, where they are of no value.

Hence, it is most essential to keep this in view in planning improved communications. If we do not, we shall be deterred from attempting them under a false imagination, that the interest of the money will be a much greater charge upon the carriage than it really will. Thus, if the cost of a railway is 30,000 rupees a mile, and the present amount of traffic 100,000 tons a year, and the actual cost of working the road two pice, or one farthing a ton per mile, the following calculation might be made of the

rate at which goods must be charged, to give ten per cent. interest.

10 per cent. on 30,000 rupees=3,000 rupees.

Which divided among 100,000 tons would be	6	pice per ton.
Add cost of transit	2	"
Total	8	pice.

or about one-half or two-thirds of what it would be on a good common road, which would perhaps more than quadruple the present traffic. But if a great reduction of rate took place, so that the quantity were increased five-fold, the calculation would be—

10 per cent on 30,000 rupees=3,000 rupees.

Which divided by $\frac{1}{2}$ million tons would give, per ton	$1\frac{1}{5}$	pice.
Add for cost of transit	$1\frac{2}{5}$	"
Total	$2\frac{3}{5}$	

or one-fifth the cost on good common road, which would probably, at the very least, increase the traffic five-fold, and necessitate the addition of a second line of rails as soon as the first was in operation. In the second calculation, I allow a lower cost of transit, because that of management and other things would be distributed over a greater surface. In England the actual cost of working the railways

is two pice, or one farthing per ton per mile; it will certainly be less in this country at the same velocity.

Let us take again the example of the Calcutta Railway; supposing it cost 1,20,000 rupees a mile, and that 10 per cent. profit is to be allowed for, and that it were capable of conveying the whole of the present traffic.

10 per cent. on 1,20,000 rupees=12,000 rupees.		
Divided over present traffic of two million tons.	$1\frac{1}{5}$	pice.
Add for cost of transit	$1\frac{2}{5}$	,,
Total	$2\frac{3}{5}$	

which is, perhaps, three-fourths of the present cost by the river, allowing for interest and insurance in the present mode of transit. This would, no doubt, cause a large increase of traffic; but if the interest is paid entirely by passengers, which it may probably be, the goods would cost only one and two-fifths pice per mile, or about one-fourth of the present cost, which would probably double the present traffic. It could not, of course, have by any means so great an effect on the traffic, as in the case of a change from a common road, where the railway would take off one anna a ton from the cost, whereas, in the above case, it might take off only two pice. It must be observed, that the above calculation is made only

on the ground assumed by the railway projectors, viz., that a double line of railway could carry two million tons a year, besides passengers, it is not intended to imply that such a thing is possible.

The case will be still stronger if we take an imperfect road, and substitute for it a good steam canal. Such a work can be executed over a great part of this Presidency for 15,000 rupees a mile, the interest of which would be paid by the passengers; thus—

10 per cent. on 15,000 rupees = 1,500 rupees.

which would only be one pie, or $\frac{1}{8}d.$ per mile for 1,000 passengers a day. The charge on goods would then be about half a pie per ton per mile for considerable distances (the rate at which goods are now carried on the Mississippi), which is one-thirtieth of the present cost of transit on the ordinary roads. At this rate almost anything could be moved, and it will be curious to see the effect of it upon an important line of communication. In investigating the subject of a proposed line of traffic in a country so entirely without communication, the question is not, What is the present traffic? but What are the comparative prices of any great staples at different points on the line? In India it will often happen that the main traffic on a new line of cheap transit is one that is entirely created by the new work.

The most important point shown by the above considerations of the present cost of transit is, that it

is absolutely essential that we should very greatly reduce it; that no trifling reduction will at all answer the purpose, much less will the plan of the railway projectors, to convey at a rate as high, or higher than the present, answer any useful purposes. The present rate is utterly destructive and ruinous. The country cannot thrive either under it, or even under a rate approaching to the present one. What has been shown above of the proportion of the cost of transit to the value of the principal goods moved, shows that it is not a small reduction that will effectually relieve the country, much less is it an increase of speed of transit without any reduction of price. No greater mistake can be made than to suppose that an increase of speed is the main thing required. If the grand railways effect nothing more than what their advocates state, they will do nothing to any purpose. In the pamphlets and reports about the Bengal and Bombay railroads, they talk of a charge of 8 p. to 2 as., or 1*d.* to 3*d.* per ton per mile. If this is all that the most perfect railways can do for India, and there were no other means by which something could be accomplished, our case would be hopeless indeed. If India is to advance in anything, *it must have cheap transit, really cheap, transit at rates one-tenth or one-twentieth of those at present prevailing.* In planning the great railways, the real points to be attended to have been entirely lost sight of, and this, the first, especially. When the pro-

jectors talk of 1*d.* to 3*d.* per ton per mile, they do not consider the fact that a good common road will carry at $1\frac{1}{2}d.$, and that the imperfect, unimproved natural water transit, where it exists, costs only $\frac{1}{2}d.$ In the Bengal reports, they make out that the river transit costs 9 pice ($1\frac{1}{8}d.$) per ton, but this is more than double the real cost. One of the fallacies in the calculation is, that interest is charged on goods at 40*l.* a ton, whereas the great bulk of the traffic is in grain, value 3*l.* a ton ; salt, 3*l.*; sugar, 12*l.* or 15*l.* ; saltpetre, 18*l.* ; iron, 10*l.*, and probably not one-twentieth of the goods is worth 40*l.* a ton.

What we have now to do is to discover means whereby the cost of transit may be reduced materially, so as to give a real relief to the country, and enable it to compete with other countries. Till this is accomplished, nothing is done. All our immense advantages of soil and climate, and cheapness, and abundance of labour, are lost, or at least the greatest part of them. This is well shown in the state of the Berar cotton trade ; it is stated by those who have the best means of knowing, that cotton is actually grown and sold at four-fifths of an anna, or $1\frac{1}{4}d.$ a lb ; to this about $\frac{3}{4}d.$ (half an anna) is added in bringing it into the great cotton marts of the district where it is cultivated. Fully 1*d.*, or two-thirds of an anna, is added in conveying it to Bombay, and more in taking it to Calcutta ; another penny is added to it in bringing it into the English markets, and thus it

arrives at Manchester at a cost that only puts it on a par with American cotton grown by slave labour at an enormous expense. At least one anna per lb. could be taken off this cost by improved communications, and by throwing open the country where so favourable a climate and soil are found for its growth. It is not merely that for want of cheap transit, a direct charge of a penny or more is added to the cost of the cotton, but for the same reason, food, salt, &c., are three or four times the price they need to be. This is only one of many ways that the price of the cotton is indirectly augmented. At present the purchasing of the cotton from the cultivators is entirely in the hands of the ignorant, short-sighted, oppressive native merchants. The natives begin to be very sensible of the advantage that it would be to deal directly with the European; but nothing can deliver them from the present system without an open communication with the ports, giving Europeans free access to the districts, and gradually removing the absurd fancies that mercantile men have about living in the interior of the Peninsula, as if they could not do it without great risk of their lives. The extent to which the cost of the produce of India may thus in different ways be reduced in foreign markets cannot be calculated. The mere reduction of the charge of transit is by no means the total amount of the diminution of the cost that may be effected.

But where the distances are so great, the value of

produce so small, and the cost of present carriage per mile so enormous, it is not a trifling reduction that will do. Till this point is understood, nothing effective will be done towards the real improvement of India. I am satisfied, as I have stated, that in fact the money now paid for transit, and lost for want of it in India, is equal to the whole amount of taxation.

It is not surprising that this essential, fundamental point of the necessity of a great diminution of the cost of traffic should have been treated as of no consequence by the engineers and others concerned in projecting the great railways. Their views were naturally contracted to this comparatively insignificant part of the subject, viz. Will such a railway pay to the shareholders? But that it should have been so lost sight of by the public and the authorities is indeed surprising. The question for the government to consider is, What does the country really require in the way of transit, and by what means can the greatest advantage be obtained for the whole community? The interest of the shareholders in a line of railroad, and that of the community, may be diametrically opposed. If a railway on an important line is constructed on so expensive a plan, so as to require a high rate of charge to enable it to pay a good interest, an irreparable evil will have been done. The whole power of an influential body, influential and powerful just in proportion to

the amount of capital expended, will be brought to bear on that line, not to secure cheap transit, but to prevent cheap transit ever being obtained on it.

If the proprietors of the Bengal Railway, for instance, charge, as is proposed in the pamphlets, 1*d.* per ton per mile, there seems no hope that that line will be ever favoured with a cheaper communication than it has at present by the river. While other parts of the country were favoured with this most essential advantage, probably no power could be found that would be sufficient to prevent this, the most important line by far in all India, from being sealed up against the use of any means by which cheap carriage could be obtained. Of the various means that could be used for this purpose, and there are several (for I am certain that on that line transit could be carried on at the rate of one pie per ton per mile as well as on the Mississipi), there would be no probability of any being adopted while the owners of the four millions sterling invested in the railway felt that the whole of their property depended upon their successfully resisting all improvements.

Happily, the matter is very far indeed from being as stated in the railway pamphlets; even with all its present imperfections, the river transit will provide for the conveyances of goods at a much lower rate than 1*d.* per ton per mile. But of the railway

accomplishing the main object, that of materially reducing the charge, I see no prospect; so that certainly, at present, the probability is that, whatever may be effected elsewhere, no material improvement will take place in the rates that will be charged on this most important line, which ought to be the line of greatest traffic in the world.

But what means can be found that will really relieve the country from this intolerable burden of the cost of transit, supposing it at this moment amounts to 15 millions a year in actual payments, besides the loss of as much more from the inability to move ten times the quantity in those things which will not bear the present charges? Is the case really hopeless? Have we really no alternative but to lay out a lac of rupees a mile, or 200 millions sterling, on the 20,000 miles of main line required, and then to be shut up to paying for ever nearly as much as we do now? Hopeless, indeed, would the state of India be if this were the real state of the case. But nothing can be farther from the fact. On almost every line in India, the cost can be reduced to one-fifth or one-tenth of what is contemplated by the great railways.

We have, first, the natural water communications, and the question is, What may be done by means of them? The following paper, written some time ago, may be properly introduced here, as showing

more fully what extraordinary openings we have in India for improving the country by means of the rivers:—

"But by no means the least important part of the present project (the Godavery Delta Works) is its helping to open the navigation of the Godavery. The part of this river between the hills and the sea was in the dry season exceedingly shallow in places, sometimes only a few inches deep. The annicut greatly diminishes the hinderance to the navigation of the river. Below the annicut there will be a constant deep channel to tide-water. Through the hills the water is a great depth, and the first serious obstacle occurs at Badrachellum, 130 miles from the coast. From thence to Woonie, on the Wurda, 300 miles, which is 80 miles from Nagpore, by Captain Fenwick's account, there are six obstructions from rock, all which might be removed or diminished at a moderate expense. That gentleman, when employed in connection with Messrs. Palmer's house, repeatedly navigated the river with timber and loaded boats. He cut through one rocky obstruction at a cost of only 400 rupees. In connection with the Delta works, it seems of the highest importance to open this most valuable line of communication through a country a great part of which has hitherto been almost beyond the reach of commercial enterprise. By Captain Fenwick's account, there seems no doubt that the cotton of Berar and

many other things may be conveyed to a port at one-tenth of what is now paid for land-carriage to Bombay.

"It is highly probable that the Kistnah also may be navigated to a great extent; but I have no positive information on that point."

In the present great question of the cotton supply, there seems to be scarcely any point more worth investigation than this opening of the fine cotton countries of Nagpore to the coast. No doubt the cultivation would extend rapidly along the whole line of the Godavery. It seems now to be generally acknowledged that Berar is naturally the most suitable climate and soil for cotton for the English market, and that therefore we should make it our grand effort to open a cheap line of communication with it; and it is certain that no other line can possibly compare with that of the Godavery for bringing this cotton to the coast. Captain Fenwick tells me, that during the three years Palmer's house brought their capital to bear on this tract, the cultivation of cotton and the general welfare of the people increased surprisingly. There is thus a line of 500 miles of the cheapest communication, leading into the very heart of the country, to be had almost for nothing; even if five lacs were spent in improving it, it would still only cost 1,000 rupees a mile.

In the paper on the Berar cotton by Mr. Ashburner, read before the Asiatic Society, in 1837, the

importance of this subject is shown on the very best authority. He states that cotton can be cultivated at 30 rupees for a Bombay candy (less than 1*d.* a lb.), and that the only obstacle to its unlimited production is the cost of transport; that it is sent to Bombay on bullocks at 24 rupees a candy (less than three farthings a lb.), taking seventy days on the journey; that large quantities cannot reach Bombay before the monsoon, which is consequently liable to be damaged or destroyed; that there was at that time a traffic of 20,000 tons a year in salt and Berar cotton; that if a good bandy road were made, there would be a saving of 16 lacs a year. He then goes on to say: "It may be as well, however, to show the productive powers of the country more clearly, to instance the increase which has lately taken place in the amount of cotton exported from Bombay. From 1828 to 1835, the exports averaged 178,000 bales a year, and remained nearly stationary. But the high prices of the latter year led to more extensive cultivation; and, notwithstanding numerous obstacles to production, the presidency of Bombay last year produced and exported no less than 290,000 bales of cotton being an increase of 112,000 bales within the year. Some portion of this increase, no doubt, is attributable to an unusually good season, but by far the largest share arose, as the reports of the revenue collectors show, from extension of cultivation alone." Here, then, is a specimen of what India is capable

of doing under favourable circumstances; and there can be no question whatever that the production of cotton would, with good roads to the interior, go on increasing as rapidly as it increased during the last twelvemonth; for the stimulus to cultivation would be as great from decreased expenses as it has lately been from increased prices.

"Thus, with proper management, we might reasonably expect to see the exports of the country, in this staple alone, swelling at the rate of 100,000 bales per annum, and amounting probably at no distant period to a million of bales. And what would be the consequence in other respects? Besides benefitting the revenue, and improving the condition of the people of India, such a trade would give employment to a vast amount of British shipping (400,000 tons) at the same time that it created a greater demand for the manufactures of the mother country."

Now if this cotton, instead of being carried, as Mr. Ashburner proposes, by a bandy road, were conveyed down the Godavery at the rate at which goods are carried on the Mississippi, or one pie per ton per mile, or about 2½ rupees per ton for the whole distance, there would be a saving of 70 rupees a ton, or of 21 lacs, on the traffic of 20,000 tons, besides saving the interest, insurance, waste, &c.

Think of a great portion of this cotton being carried from the banks of the Godavery, 500 miles from the sea, by a land carriage of 500 miles to

Mirzapoor, to be embarked on the Ganges, a point 550 miles from Calcutta. But the important point in Mr. Ashburner's paper is, his testimony to the astonishing increase of production consequent on an increase of price; showing clearly the grand fact, that everything within that tract of country is in a complete state of preparation, and that nothing is wanting but a relief in the cost of transit to England, to make the cultivation spring up to almost any extent. There are the climate and soil required for a good marketable cotton for England, and there are the people, the cattle, the enterprise, and all other requisites. This line of transit would probably cause a saving of full 1½*d.* a lb., five times as much as would be sufficient to give a material stimulus to the trade.

But the comparative prices in this central tract with those on the coast will strikingly illustrate what the effect of communications is, and what the state of a country must be, notwithstanding every other natural advantage, if it be not opened up by cheap means of transit.

	Cost per ton.		Difference.	Per centage of the difference.
	In Berar.	At Coringa.		
Rice	124	45	79	175
Cotton . . .	186	325	139	75
Wheat . . .	31	66	35	113
Salt	105	30	70	200

From this comparison some idea may be formed of the creation of property by opening a communication on this line of 500 miles. At 1½ pie per ton per mile, the cost of transport would be 2¼ rupees a ton by the river, and allowing a land carriage of 50 miles on an average, by railway, at four pice, and 10 miles by common roads, at three annas, the total cost of conveying a ton to and from the port would be—

500 miles of river transit, at 1 pie .	2½ rupees.
50 of railway, at 4 pice	1 ,,
10 of common road, at 3 annas . .	2 ,,
Total .	5½ ,,

There would then be a creation of property by the transport of a ton of

Rice	74 rupees.
Cotton	134 ,,
Wheat	30 ,,
Salt	70 ,,

If the Rajahmundry rice and salt are thus placed fully within the reach of the inhabitants of these districts, and their wheat and cotton placed freely within the reach of the manufacturers of England, it is impossible to say what the traffic on this line might become; the wheat especially might be manufactured into flour by the abundant water power of Rajahmundry, and conveyed to England by hundreds

of thousands of tons. As wheat, it could certainly be landed in England at 4*s.* a bushel, and as flour, at a still cheaper proportional rate.

The saving or production of property might thus be something like this, by opening the Godavery:—

200,000 tons rice at 74 rupees	. . .	148 lacs.
100,000 tons cotton at 134 rupees	.	144 ,,
200,000 wheat at 30 rupees	. . .	60 ,,
90,000 salt at 70 rupees	. . . .	63 ,,
Total	.	405 lacs.

The outlay to produce this trade might be, river improvements	. . . .	10 lacs.
200 miles of railway at 10,000 rupees	.	20 ,,
Total	.	30 lacs.

Of course the traffic might extend far beyond this, for the tendency of the whole thing would be for Rajahmundry to supply a large proportion of Berar with food, while that district, in its turn, could feed an immense population in England, and also supply them with materials for their industry. It is thus that almost any amount of property may be produced by an outlay on communications, however small.

How immense might be the effect of thus supplying Manchester at once with cheap cotton; how powerfully would it certainly affect the trade of that city! Who can possibly estimate the effect of thus

giving it such an immense additional advantage in its competition with other countries. In our race with America, this lowering of the cost of flour and cotton would produce results far beyond any possible calculation.

If the gain by the reduction of cost of these products were equally divided between the two parties, the buyer and seller, it would make the cost of cotton in Manchester 4*d.* instead of 4½*d.*

Wheat in Manchester .	4*s.* 9*d.* . .	5*s.* 6*d.*
Rice in Berar	85 Rs. a ton .	124
Salt in do.	67½ ,, .	105

But it is well known that the real division of the profits is much more in favour of the purchaser, in such cases, when trade is open; a little addition of price in a country already full of population, and with an unlimited extent of suitable soil, would be a sufficient stimulus to an immensely extended production; and this is expressly stated by Mr. Ashburner, a gentleman perfectly acquainted with the state of things there. The increase of produce would be so great as very soon to cause its supply to the consumer, without an excessive profit to the producer. Nay more, if Berar were supplied with rice, salt, and many other things, at a much lower cost than they now pay, they could afford to provide the cotton at a price actually lower than at present, and yet with an increased profit.

But with respect to the effect of such a communication,—whoever divides the profit,—the facts are certain, that the people of Berar are at present paying 124 rupees per ton for rice grown on the spot, whilst they would supply themselves with it from Rajahmundry for 30 rupees; that they are paying 90 rupees per ton for salt, while they might get it for 35; and that the Manchester manufacturers are paying 40*l.* a ton for Berar cotton, while it could be supplied to them for 30*l.*; and 10*l.* a ton for wheat, while it could be supplied to them for 6*l.*

The things that I have enumerated above are only a portion of the various products which would be interchanged. Besides numerous smaller articles of food, such as chillies, cocoa-nuts, onions, &c., which are produced so excessively cheap in the irrigated lands of the delta of the Godavery, but which are scarce and dear in Berar, who can doubt that, if these soils and countries, instead of being in the paralyzed state they now are, were carrying on a most extensive and profitable trade with other parts of the world, they would immediately demand vast quantities of English manufactured goods, and thus again, in another way, produce an immense effect in England?

There thus seems to be no reason why the Godavery may not become the line of a trade of a million tons a year, when once the pent-up treasures of its basin

effect a breach in the barriers which have hitherto shut it up.

Respecting the nature of the navigation of the Godavery, I should state the following points.

The fall of the river, from near Chandah to the sea, averages about one and a quarter feet per mile; but this is not quite equally distributed. Captain Fenwick states that there are six rocky barriers in its bed, which could be improved by blasting at no great expense. The fall of one and a quarter feet per mile is very moderate for steam navigation; with a depth of ten feet it would give a current of about three miles an hour. In Mr. Ellet's remarkable report on the Mississipi, he states that the Alleghany has been navigated as high as where the fall is four and one-third feet per mile, and the Ohio at Pittsburg has a fall of about one and a half feet a mile, where steamers are innumerable. He says, "by observing the descent of the Alleghany from Franklin to Pittsburg, we may conclude that rivers, of which the fall does not exceed two feet per mile, are navigable for steam-boats, unless there be great irregularity in the distribution of that fall. In the event of such irregularity existing, rivers having an average descent not exceeding two feet per mile, if well supplied with water, must afford exceedingly good navigation between the rapids, which must be very remote and easily overcome."

"We learn, also, from these tables, that a descent

of nearly 4 feet per mile is not incompatible with the existence of steam-boat navigation, if the supply of water be well maintained, for a steam-boat has ascended the Alleghany as far as Olean point, overcoming, in places, a slope of nearly 5 feet per mile." In this report Mr. Ellet shows how easily the summer navigation of the Ohio might be improved by storing water in tanks to be discharged when the river is low; and this is perfectly applicable to the Godavery. For instance, an additional depth of one foot, at a ford 200 yards broad, where the current was two miles an hour, could be obtained by the supply of 5½ millions of cubic yards per day, or for two months by 330 millions, which could be stored probably for 1½ lacs of rupees, perhaps much less, a sum equivalent to 300 rupees a mile on the whole length of the navigation, or perhaps the two hundredth part of the cost of a complete railroad, from which some idea may be formed of the facility with which an additional depth of water might be given if necessary.

We reckon that we can easily find situations in the Carnatic, where water can be stored for one rupee per 1,000 cubic yards, and I have reason to believe that the country is much more favourable for storing water in Berar than here, because the country there has a less fall, and consequently a bund of a certain height will retain a greater breadth of water. Captain Fenwick talks of the Godavery being now navi-

gable for eight months in the year, meaning, as I believe, that there will be not less than three or four feet of water during that time. Supposing the quantity of water to be 500,000 cubic yards per hour, at the most, in those eight months, and that it diminishes during the other four to 100,000, it would on an average require an additional 200,000 cubic yards an hour for four months, to keep the river in that state which Captain Fenwick calls navigable. The amount required for this purpose would then be 200,000 × hours × 122 days = 600 millions cubic yards. I have no doubt this could be stored for three lacs of rupees, which, divided over 500 miles of navigation, would be equal to 600 rupees a mile. The great advantage of this mode of improving the navigation is, that no works would be required in the bed of the river, requiring much skill in construction, and care and attention in management, and involving risk of injury in such a way as to stop the navigation even for a time. No doubt some trifling work, such as blasting rock, &c., might be performed in the bed of the river, which would greatly improve the navigation also, but this would be simple and of trifling cost—in this way I have no doubt that a depth of at least three feet could be retained in this river throughout the year at a fiftieth part of the cost of a double railway, and that goods could be conveyed by it at one-fifth of the cost of railway transit, and this with a speed of 150 miles a day up

the river, and 200 miles down the stream, a speed that would certainly answer all present purposes. Some years ago, when some reports on the navigation of the Severn were sent me by a civil engineer at home, I suggested to him this mode of effecting his object, the Welsh lakes affording him peculiar advantages for storing water, but I have not heard whether anything was done about it. Had this plan been adopted in the Ganges, it is literally incalculable what the advantage of it would have been. The cost of ten miles of railway would have given a fine navigation of probably three or four feet, and doubtless have reduced the cost of transit in the dry season one-half. A reduction of two pice a ton per mile on 1½ million tons carried 1,000 miles, would have been a total saving of 150 lacs a year, besides the saving of time and risk, and it would have made a total change in the steam navigation of the river.

Of course, the water, besides being used for the navigation of the Godàvery, would, on its arrival at the annicut, be distributed for irrigation, for which it would be worth forty times what it cost to store it; so that, if necessary, no part of its cost need be charged to the navigation. But the river is immediately available for navigation in its present state, with vessels of small draft, for eight months in the year, at least; and it must be remembered that the canals in Canada and New York, which have pro-

duced such prodigious results, are only open six or seven months in the year. The only reasons why it is not used are, the want of enterprise in the natives, and the interferences of petty Zemindars on its banks. The Government can remove the latter in a moment, and can give the necessary stimulus to get over the former, by setting the example of navigating it themselves.

This matter of the upper Godavery navigation is worthy of a far more particular and careful report than would be suitable in this paper. I would only mention, as favouring highly the advisableness of undertaking such work as this, the astonishing success that has attended the Paumbam works. When I was sent there in 1822, the whole amount of traffic was 17,000 tons a year, though the whole of the cotton from Tinnevelly was carried then through the Pass, to Madras. The traffic is now sometimes more than that in one month, though the cotton is almost all shipped at once from Tuticorin, and the annual traffic is 168,000 tons, or ten-fold the former quantity. Such has been the effect of deepening that passage from 4½ to 10½ feet. Such an instance is an unanswerable proof of the fact, that the traffic is waiting for the communications, and not that the communications have to wait for the traffic, as some still suppose. How strangely the state of the question of communications in India is misapprehended, as has been singularly shown in this case, as

before stated, by the perfect indifference with which the opening of the Godavery was treated by the Government of India.

1st. The Company's Government, who are so deeply interested in everything that concerns the whole of India, would certainly gain a revenue of many lacs by the increased demand for salt.

2nd. The Government of Nagpore and Hyderabad would undoubtedly feel the effect of such an increased demand for their produce in numerous ways.

3rd. The manufacturers at home are most deeply interested in this, which I feel confident is the best opening which has yet been discovered for obtaining for them an increased supply of cotton on the one hand, and an increased market for all English manufactured goods in the other.

4th. The anti-slavery body are nearly concerned in it. Nothing, so far as appears, would tend so much to weaken the slavery system of the United States; for the enormous profit now realized from their partial monopoly of the cotton trade is one of the chief incentives to it.*

5th. The shipping interests are concerned in it. An addition of 50,000 tons of cotton alone, a year, would give employment to 150 large ships, above

* "Well," said St. Clare, "suppose that something should bring down the price of cotton, once and for ever, and make the whole slave property a drug in the market."

what would be required to bring the same quantity from America.

Further, I would remark, that though undoubtedly the efforts that have been made to introduce the American varieties of cotton into India are most commendable, yet it seems certain now, that had a tenth part of the same money and pains been expended on the opening up of this magnificent cotton country by cheap communications, immensely superior results would have been obtained. Of the growing importance of this subject we have proof in a recent work of an American.* It is the production of a practical planter, and though we do not much admire the blustering style in which it is written, we admit the force, and have the means, in some instances, of testing the accuracy of his statistics. Its general object is to show that the cotton cultivation, though it has contributed so powerfully in the past to the wealth of America, is now irrecoverably on the decline, and must be abandoned for the cultivation of tea, coffee, indigo, and other plants. From the statistics furnished, it appears that cotton, in twelve years, has declined in price 30 per cent. yearly; rice, in nine years, in quantity and quality, 15 per cent.; tobacco, in quantity, the last five years, $2\frac{2}{3}$ per cent.; that bread stuffs are returning to the same amount of exports that they were prior to the failure of the potato crop in Europe, and that

* Bonynge's "Future Wealth of America."

sugar cultivation is not advancing. Under the present prices of labour in America, there is no possibility of extending these articles, and, except tobacco, it is feared that they will all greatly decline. Cotton cannot be cultivated under 5½ cents per lb.; whereas, India can produce it and land it in Liverpool at 7 cents per lb. After a fourteen years' residence (as a planter) in the East, and after a tour through South Carolina and Georgia, Mr. Bonynge is constrained to admit that India has every means of producing as good cotton, and much cheaper than America. And he asserts, that had it not been for the potato failure, and the timely aid of California, America could never have borne the decay of her principal staple for the last ten years.

What, then, ought the Godavery Delta to become, as the outlet of the whole trade of the basin of the Godavery, containing 1,30,000 square miles, and when it supplies that immense region with rice, salt, tobacco, sugar, chillies, and numerous other things, which cannot be produced at four times the price in inland districts? Is it too much to expect that an immense mercantile city will spring up on the shore of the harbour of Coringa, from which a million tons of wheat, cotton, oil-seeds, sugar, rice, tobacco, hemp, &c., will be exported, and into which English manufactured articles, to an immense amount, will be imported for the use of the 12 millions of people, who will thus be so enriched as to become extensive con-

sumers of such things? I cannot see anything to prevent this, if the country continues to be blessed with peace, unless, which is scarcely conceivable, it be insanely determined not to take the first step towards opening the navigation of the Godavery. Probably little more than the first step is required; for, in such a case, when once the trade begins it must go on,—nothing can stop it.

Upon the whole, there seems to be no possible means of transit that can surpass steam communication by water in point of cheapness, and that, too, at a speed which will certainly abundantly answer all our present purposes. The rivers that may be easily improved are, the Ganges, Jumna, Gogru, Chumbul, Gunduck, Soane, Bhugirutty, Mahanudda, Nurbudda, Godavery, Kistnah, Wurdah, Munjeru, and no doubt several minor rivers.

Perhaps in all there may be found 5,000 miles of river navigation which can be made thoroughly convenient. All rivers which have not a greater fall than two feet a mile will be quite available. Such a fall, with a depth of twenty feet, will give a current of about 5½ miles an hour; and with a depth of five feet, of three miles an hour; and it must be remembered that the number of days in the year in which Indian rivers are nearly full is very small indeed: for eight or nine months in the year they are very low. If on these lines, which it must be particularly observed will bear by far the greater

portion of all the traffic of India, transit can be effected at one pie or one-eighth of a penny per ton per mile, our main object will be already gained. We know that on the Ganges there is now a traffic of upwards of a million tons a year; and if this river were greatly improved by keeping the quantity of water always up to a certain height, there can be no question that the amount of traffic would be prodigiously increased, probably at least doubled, and more likely increased four-fold. Perhaps the greatest improvement that could be made in communications in all India, in comparison of its cost, would be by the construction of a weir across the Ganges below the head of the Bhugirutty, to turn the whole stream into that river in the dry season. This weir would keep the Bhugirutty navigable throughout the year, and effect an immense traffic. The weir across the Godavery, twelve feet high, with a clear water-way of 4,000 yards, has cost 8½ lacs, including six sets of sluices, three locks, &c. If the Ganges weir, six feet high, cost five lacs, the interest, 25,000 rupees, would be equivalent to a charge of 3½ pice per ton on the present traffic, or, taking the distance from the head of the Bhugirutty to Calcutta at 150 miles, one-tenth pie per ton per mile, besides the benefit to travellers. The Godavery would undoubtedly convey the whole traffic of the basin of that river, which cannot at present be less

than 150,000 tons a year, and which would increase in a far greater proportion than that on the Ganges, for this obvious reason, that there is at present no water-carriage in the former. All goods are carried at about three annas a ton per mile; and if the cost were reduced to one pie, it is impossible to say what the traffic would be: but there can be little doubt that it would be increased five or six fold, or to a million tons per annum. If, as before suggested, two millions of people employed in cotton cultivation were fed from the irrigated Delta at the mouth of the river, that alone would call for a traffic of 700,000 tons a year. In the same way the Indus, the Nerbudda, and the Kistnah would undoubtedly convey the whole trade of their basins; though what the probable amount of it would be I have no means of judging.

We should thus at once provide for the really cheap conveyance of probably half of the whole traffic of the country; and if the cost of transit by the Ganges were thus reduced to half of what it now is, with a similar reduction on the Indus, and if the change of water for land-carriage on the lines of the other rivers named were to reduce the cost there from three annas a ton per mile to two pice, there would be a saving to the country of many millions sterling.

The following calculation is not given even as an

approximation to the actual saving, but it will at least give some idea of the extent of the amount that might be saved directly:—

	Millions sterling.
Saving on 1,200,000 tons conveyed 1,200 miles on the Ganges, at 2 pice per ton per mile . .	$1\frac{1}{2}$
Ditto on 500,000 tons carried 450 miles by the Godavery, at 3 annas	4
Ditto on 50,000 tons carried 500 miles on the Indus, at 2 pice	$\frac{1}{10}$
Ditto on 50,000 tons carried 400 miles on the Kistnah, at $2\frac{1}{2}$ annas	$\frac{1}{3}$
	6

besides the amount saved on the Nerbudda, Soane, &c. But as besides this there would be profit on all the additional traffic on the Ganges (for which we may safely reckon as much more on that river), there might be thus a saving of ten millions. This is entirely exclusive of the saving on the transit of passengers, and all the immense effects of such improved lines of transit, which cannot be calculated in money.

The following extract, from the professional papers of the corps of Royal Engineers, relative to the Halifax and Quebec Railway, contains many things bearing upon the point under consideration:—

In the United States they are well aware of the increased value which internal improvements and communications give to property of every kind.

In those countries works have been undertaken for that object alone,—not for the mere return which the work, whether railway, road, or canal, would make of itself.

The indebtedness of the several States has been incurred almost entirely in making great internal improvements; and in the boldness and unhesitating way in which they have incurred debts and responsibilities, for the purpose of developing their resources, may be seen the secret of their unrivalled prosperity.

The State is in debt, but its citizens have been enriched beyond all proportion.

Most unfavourable comparisons are made by travellers who visit the British provinces and the United States; and some have gone so far as to state, that travelling along where the boundary is a mere conventional line, they could at once tell whether they were in the States or not.

On the one side the State Governments become shareholders to a large amount in great public works, lead the way, and do not hesitate to incur debt, for making what has been termed "war upon the wilderness;" employment is given, and by the time the improvement is completed, property has been created, and the employed become proprietors.

On the other side, the provincial governments do not take the initiative in the same manner; and hence in the settlements, and in the provinces generally, may be seen this marked difference in the progress of people who are identically the same in every respect.

Until the British provinces boldly imitate the policy of the States in this regard, and make "war upon their wilderness," their progress will continue to present the same unfavourable contrast.

The creative or productive power of canals, railways, &c., may be traced in the history and progress of the State of New York.

The Erie canal was commenced in 1817, and completed in 1825, at a cost of 7,143,789 dollars, or 1,400,000*l.* sterling. In 1817 the value of real and personal property in the city of New York was, from official documents, estimated at 16,436,000*l.* sterling. In 1825 it was estimated at 21,075,000*l.* sterling. In 1820, the population of the State was 1,372,000, and in 1830 the population of the State was 1,918,000.

The canal was found so inadequate to the traffic, that between the years 1825 and 1835 a farther sum of 2,700,000*l.* was to be expended in enlarging it.*

Making the total cost to that date 4,100,000*l.* sterling.

It has been seen that in the city of New York:—

	£.
In 1817 the official value of real and personal property was . . .	16,436,000
In 1835 the official value of real and personal property was . . .	45,567,000

Being an increase of $2\frac{3}{4}$ times in 18 years.

For the State of New York:—

In 1817 the official value of real and personal property was . . .	63,368,000
In 1835 the official value of real and personal property was . . .	110,120,000

Or an increase of nearly 47,000,000*l.* sterling in the value of property; attributed chiefly, if not entirely, to the formation of the canals.

In 1836 the amount conveyed to tide-water by the canal was 697,357 tons.

And on the 1st of July of that year there had accumulated, in the hands of the commissioners, an amount sufficient to extinguish the whole of the outstanding debt incurred in its construction.

The net receipts from all the state canals, after deduct-

* It is to be again enlarged.

ing the expenses of collection and superintendence, for the year 1847, was 449,270*l*. Villages, towns, and cities have sprung up along its course.

The population of the State, which was

In 1810 . . .	959,949
Was in 1845 . . .	2,604,495

In 1846 the value of real and personal property was estimated at 128,500,000*l*.

It will be seen from the above, therefore, that in addition to the wealth created for individuals, the canals produce a large annual revenue to the state.

The following extracts from the financial affairs and statistics of some of the States may be quoted in illustration of this part of the subject:—

1847.

MASSACHUSETTS.

	Dollars.
Total indebtedness of the State, Jan. 1, 1847 .	999,654
Credit of the State, lent to railroads . .	5,049,555
Total liabilities of the State . .	6,049,209

As security for the redemption of the scrip lent to railroads the commonwealth hold a mortgage on all the roads, and also 3,000 shares in the Norwich and Worcester, and 1,000 in the Andover and Haverhill.

PENNSYLVANIA.

	Dollars.
Public property, canals, and railroads, at original cost	28,657,402

MARYLAND.

	Dollars.
Receipts from Baltimore and Ohio railroad .	42,402
Ditto from canal companies . . .	11,550

NORTH CAROLINA.

	Dollars.
Debt of the State on account of railroad companies	1,110,000

OHIO.

	Dollars.
Debt contracted for the sole purpose of the construction of public works within the State	19,246,000
Canals, 820 miles in length, cost	15,122,503
Net receipts in 1846, after paying repairs and expenses	408,916

In 1810 the population of this State was			45,865
In 1820	ditto	ditto . .	581,434
In 1840	ditto	ditto . .	1,519,467

Or tripled nearly in 20 years, during the progress of her canals.

MICHIGAN.

	Dollars.
Debt on the 30th November, 1845	4,394,510

Total length of railroads finished, and belonging to the State, 222 miles.

This State was authorised to raise a loan of 5,000,000 dollars for internal improvements.

For the same purpose, Congress granted to this State 500,000 acres of land.

In 1840 the population was . . .	212,267
In 1845	304,278

Or an increase of 50 per cent. nearly, in five years.

INDIANA.

	Dollars.
In January, 1847, the public debt was . . .	14,394,940

By the terms of the Act adjusting this debt, it is to be

equally divided between the State and the Wabash and Erie canal. Of this canal, which is to be 458 miles long, 374 miles are in Indiana; 174 of this portion are finished, and in operation. There remain 200 miles to be completed, upon which part about 1,200,000 dollars have been expended by the State. It is estimated to cost the farther sum of 2,000,000 dollars to complete the entire canal. To cover this amount, the State is to transfer to trustees 963,126 acres of land adjoining to or in the neighbourhood of the canal.

The population of this State, in 1811, was		.	24,520
Ditto	ditto	1830 .	343,031
Ditto	ditto	1840 .	685,086

Or doubled in ten years.

ILLINOIS.

		Dollars.
1847.	Total internal improvement debt. .	8,165,081
	Total canal debt	6,009,187
		14,174,268

The population in 1830 was . . .		157,455
Ditto	1840 . . .	476,183

Or tripled in ten years.

The sales of the public lands during one year (1845)
In the United States amounted to . . 1,843,527 acres.
Producing . . . . . 2,470,298 dollars.
Or an average of 5*s.* 7*d.* sterling per acre.

But to show the effect produced by a canal or railway passing through property, the following extract may be quoted from the Report of a Board of Directors of the New York and Erie Railroad Company, in Feb. 1844:—

"The board find that they have omitted one description of property, which has heretofore been considered of great value, but the right to most of which has been lost to the

company by failure to complete the road within a certain period; the most valuable of which consisted of 50,000 acres of wild land in Cattaraguas country, near Lake Erie, and one-fourth part of the village of Dunkirk."

"An offer in writing was made in 1837 by responsible parties to take these donations, and pay further the sum of 400,000 dollars, provided certain portions of the railroad were completed within a specified time."

That is, about 8 dollars, or 33*s*. 4*d*. sterling per acre.

In Michigan 461,000 acres were granted by Congress for the endowment of a university. These lands were selected in sections from the most valuable of the State. The price of these was at one time 20 dollars, or 4*l*. 6*s*. 8*d*. sterling per acre, but became lower afterwards; 17,142 acres, the quantity sold up to 30th November, 1845, brought 2*l*. 9*s*. per acre; 69,000 acres, devoted to schools, were sold at 1*l*. 7*s*. per acre.

Such, then, are some of the results of making "war upon the wilderness."

Upon the whole, the opening and the improvements of the rivers of India would provide perhaps the cheapest possible carriage for half of the traffic of India with a fair speed, and produce an advantage in money of at least 10 millions sterling, and more likely to a much greater amount. Reckoning that so large a sum as 2,000 rupees a mile were expended upon this (chiefly in storing water, as above described), the total expense for every 5,000 miles would be 100 lacs, or one million sterling. What other means of improving the country could possibly be compared with this? Excepting in irrigation, no opening for the employment of capital equal to

this could possibly be found, nor one that would produce one quarter of these results. If four-fifths of this be employed in storing water, it would give for the Ganges, 1,200 miles at 2,000 rupees, 24 lacs, which, at 2,000 cubic yards of water stored per rupee, would supply 4,800 millions of cubic yards, or an average of 24 millions a day for 200 days, which would be equal to a gradually-increasing supply from nothing to 48 millions per day, or 26 millions per hour, when the river was at its lowest, equivalent to raising the water three feet where it was 600 yards broad, with a current of 1½ miles an hour. But so utterly insignificant is such an outlay, compared with the object to be attained, that if necessary five times as much water as is here calculated could be stored. If this water were divided between different reservoirs placed in the upper parts of the basins of the Ganges and its several feeders, the Jumna, Chumbul, &c., the total length of navigation improved would be perhaps 2,400 miles, and the cost would then be 1,000 rupees a mile, or there would be an annual charge of 50 rupees in interest, which divided between 800,000 tons average traffic, would form a charge of one-eighth pice per ton per mile: compare this with the effects of 100,000 rupees spent on a mile of railway.

When the rivers are thus turned to account, the next question is, whether on any lines canals could

not be constructed so as to give still the cheapest possible lines of transit. Whenever good steam canals can be obtained, they will of course be preferable in some respects to rivers. The principal reason is that they can be worked day and night, so as to give a speed of 300 miles a day with fast steamers. For a chiefly down trade, as that of India is on all the lines of the rivers, there will of course be an advantage in the current if not too great, which still-water canals would not have. But yet the transit on steam canals would be exceedingly cheap, certainly not exceeding half a pice per ton per mile. On the channels in Rajahmundry, in their present incomplete state, three pice a ton per mile is paid for short trips of ten or twenty miles, according to which the rate would certainly be greatly less for long voyages of 100 to 500 miles, in canals completed in every way and with suitable boats,—for the boats now used on these channels are the boats formerly used for the river navigation, and by no means the most suitable ones for canals. The cargo boats used on the Godavery works cost, including the aid of two small steam-tugs, half an anna per ton per day for all expenses, which if they passed over twenty miles a day, would give one-third pie per ton per day, and these boats carry twice the crew they would if working only on canals; and for the carriage of the coarsest goods, such as building materials, &c., for which a very low speed would be

sufficient, the cost of transit would be still lower. It must be observed that the transit on Government canals would be greatly more extensive in this country than in England, for these two reasons :—

1st. On private canals, it is not for the interest of the owners that an extremely low rate of transit should be charged; the fear of crowding the canal and consuming water prevents their reducing the tolls beyond a certain point, whereas, it would be the interest of Government to encourage the utmost possible use of the canals; and if tolls were taken on the more valuable goods, it would be advisable to let all the coarser goods go free, rather than in the least diminish the traffic. When the Government have executed such a work, it is their interest that the greatest possible use should be made of it; and probably it would be better not to levy any toll, as there would be no doubt that the indirect returns from it in increase of taxes from land and other things already taxed would much more than yield the Government interest for money so expended.

2nd. If they are made expressly to allow of their being navigated by steam, they will of course be used for many things that the canals in England cannot often be used for. With capacious locks, so made as to be rapidly filled and emptied, and the canal itself both broad and deep, they will be admirable passenger lines. The locks on the Rajahmundry channel will admit vessels of more than 100

tons, and if they are ultimately kept six feet deep, as intended, they will admit iron vessels of 140 tons. They will therefore admit of the highest speed. The steamers on the Hudson draw only four feet, with a speed of eighteen or twenty miles an hour. The passenger traffic at slow speed will be immense, because they can be carried at an expense much below that of walking. The 20-H. steamer on the Godavèry worked at a low speed six miles an hour, costs two annas per mile, and including wear and tear, &c., four annas; when tugging with 100 passengers, she would cost less per mile, as she would go faster, and the charge would thus be only half a pice per man per mile, even if there were no first-class passengers on board to pay a larger share of the expenses. Such canals could undoubtedly be navigated in this country at eight miles an hour, and at a charge of one rupee for 400 miles for the lowest class of passengers. How great the number of passengers would be on such line is curiously shown in the case of the Pulicat canal. Though this line forms at present no part of any great line of communication, but merely extends thirty or forty miles from Madras to a part of the country where there are no great towns, there are more than 100 travellers a day paying about one pie per mile, though they actually travel slower than a man walks. Were this line extended to the northward, so as to form part of the main northern approach to Madras

by land, connecting that city with all Hyderabad, Nagpore, and the northern circars, there could not be less than 1,000 passengers a day, probably several thousands, in steamers moving at a moderate speed, and charging from one-third of an anna down to half a pice per mile.

As for the lines on which such canals might be cut with advantage, that is, on which they would upon the whole be the most suitable kind of works, we have first the Ganges canal, already well advanced. Of the value of this work as a means of irrigation I need not here speak particularly; it will no doubt be a most valuable work, though the effects of such works in that part of the country seem to be unaccountably small compared with those of similar works in Madras, and though they are there accompanied with that terrible drawback which attends irrigation in all moderately hot countries—fever. But as a work of communication, there can be no question that it will be also of incalculable value. Such a magnificent canal, extending nearly in a straight line 450 miles (besides its branches of 400 miles), and terminating at the point where the Ganges, even in its present state, is navigable for steamers all the year, passing through a most populous and fertile country, will, if I mistake not, be the most important work yet executed or commenced in India. If it takes, as now estimated, 160 lacs for 850 miles, including the heavy works of the first

fifteen miles to complete the work, its average cost will be under 20,000 rupees a mile for a canal 50 yards broad and 10 feet deep at its head, and gradually diminishing, though still a good navigation at its lower end. Such a work in this country at such a price, even if intended merely for navigation, surely would be one of the greatest bargains that ever was made. If eight per cent. covers interest and management, the annual cost would be 1,600 rupees a year per mile, amounting on a trade of only one million tons a year to a charge of one-third of a pice per ton per mile; and if the interest, &c., were paid entirely by passengers, as it might very well be, it would provide that vast tract of country with a transit for goods at a rate not exceeding half a pice per ton per mile, free from all risks, and navigable by day or night at any speed that each particular kind of freight might require. Having also a current in the direction of the trade, the cost of transit will probably be the lowest that has ever yet been seen in internal transit, if it be not even lower than sea transit, which for long voyages does not now exceed half a pice per ton per land-mile.* The importance of this work at the present moment is beyond all calculation; it will show in the strongest light the difference between steam-canal communication and grand railways. If the interest and

* 3*l*. a ton from India to England, 12,000 land-miles, measured on the shortest route.

insurance are charged to the irrigation, as they well may be in this case, it will be very nearly equivalent to the total abolition of the cost of transit. The actual expense will be so small, that it will scarcely be felt in any produce. Indeed, the contrast between this and the Bengal Railway will be very serious;—the one costing 20,000 rupees a mile, and providing for the interest, &c., by its use for irrigation, and conveying goods at certainly half a pice per ton per mile, and first-class passengers at perhaps two pice, the other costing 100,000 or 1,20,000 rupees a mile, and charging, according to the reports, eight pice per ton, and probably at least four pice. The canal may certainly be worked at 300 miles a day for passengers, and the railway may be worked at 700, but the advantage of this in this country, at present, is utterly insignificant in comparison of that of reducing the *cost* of transit.

Let us suppose that 500,000 tons of goods were carried by each of the two works at the above prices for 450 miles, the account would stand thus:—

500,000 tons 450 miles at 4 pice . .	47 lacs.
Interest on $1\frac{1}{4}$ lacs × 450 at 5 per cent.	28 ,,
	63
500,000 tons 450 on canal at $\frac{1}{2}$,,	6
Annual difference . .	57 lacs.

or half a million a year. If the canal had been continued on to Calcutta at the same cost, viz.,

20,000 rupees a mile, probably the valley of the Ganges would have had the greatest advantage in the way of transit that could have been found for it, or indeed that could be found in the world.

We have thus, however, 850 miles of noble canal in a considerable state of forwardness; and there cannot be a doubt that, even now, it ought to be continued to Calcutta, giving 500 miles more. We have not yet seen what a double railroad is capable of conveying, but it certainly cannot accommodate a trade of two million tons a year, or 7,000 tons a day, unless the passenger trains are restricted to the same speed as the goods; and if they are, the advantages of a very high speed, for which so much has been sacrificed, will be lost, and the railway would, even in this respect, have no advantage over a canal. It is evident that the railway in this one line does not, in reality, the least remove the necessity for a canal. It is still constantly supposed that railways and canals are directly antagonistic works, though the contrary has been so fully proved both in England and America. So far from the railway between New York and Buffalo having superseded the canal, the latter work has had 20 millions of dollars expended in its enlargement within a few years, and it now carries the great mass of the traffic, though it is closed by frost for five months in the year. Even if the railway could accommodate 7,000 tons a day, there cannot be a

doubt that as much more would be conveyed by a canal, if it were worked at half pice per ton per mile. Even between Manchester and Liverpool, where there is a much smaller traffic than here, there are no less than four lines of communication, all in full use.

This is another point which shows how narrow a view has been taken of the subject. Even with respect to this one particular line, the question has not been asked, how can this actual amount of traffic be best provided for? which was the proper question for the Government and the public. There can be no doubt whatever, in fact, that the great mass of this traffic will be untouched by the railway; it will continue to come down the river just as it does now. There is little probability that the railway will convey more than 2,000 tons a day at the utmost.

The providing for the remainder of this traffic brings us to the question, Which would be the best, to form a perfect canal, or, as before suggested, to throw water into the river? There can be no question that the canal will be in every way superior to the river, however much it may be improved. And further, that the cost of transit, including interest, will still be much less on the canal than on the river. But there is this strong argument in favour of first improving the river, viz., that it can be done at one-tenth the cost, and consequently, in

one-tenth the time, that a canal can. And this brings us to the second fundamental point in the general inquiry about communications in India, viz., the time in which extensive lines can be opened throughout India. And this, in my opinion, has been the grand evil of all, arising out of this unfortunate mania for English railways in India, viz., that in following this illusion of high speed of transit, we have been effectually turned off from the great object of all, viz., speed in executing communications. No man can be more sensible than I am of the advantages of speed of transit, and in England it was a vital point; but it is utterly insignificant in this country, in comparison of the importance of quickly laying open the whole country. In this respect, then, high-speed railways are, in fact, what the Australians called their bullock waggons, "crawling nuisances;" crawling across the country at the rate of ten miles a year, while we ought to be getting over 5,000 miles in that time. What will be the results, even in respect of speed, of this mode of proceeding? that at the end of ten years we shall be able to travel at thirty or forty miles an hour from Calcutta towards Lahore, 100 miles, and to creep over the other 20,000 miles of main lines as we do now. In the meantime, what are we spending on transit throughout the country? Perhaps fifteen millions a year.

Suppose we spend 100 lacs a year on those rail-

ways and accomplish 100 miles, what will be our position at the end of twenty years?

Expenditure.

20 years at 100 lacs . .	£20 millions.

Extent of railway opened .	2,000 miles.
Main lines required . . .	20,000 ,,
Remaining unexecuted . .	18,000 miles.

Estimate of Results.

500 miles of road leading out of Calcutta, traffic on . .	500,000 tons a year
Saving on ditto as compared with river transit . . .	Nothing.
1,500 miles on other lines, average traffic	50,000 tons.
Saving on ditto, as compared with land carriage at 2 annas per ton per mile, per annum	90 lacs.
Ditto in 20 years, allowing half that amount for the whole period	900 lacs, or 9 millions sterling.

Now, if instead of expending 100 lacs a year for twenty years on complete railways, the same time

and money are spent in other ways, the following might be accomplished.

5,000 miles of river navigation improved at 2,000 rupees	100 lacs.
2,000 miles of coast canal at 3,000 rupees	60 ,,
3,000 miles canal on other favourable lines at 5,000 rupees . . .	150 ,,
14,000 miles of cheap single railways at 12,000 rupees a mile . .	1,680 ,,
Total .	1,990 lacs.

For which we should have good river navigation	5,000 miles.
Coast canal	2,000 ,,
Other canal	3,000 ,,
Cheap railway	14,000 ,,
Total .	24,000 miles.

Results.

Saving on 500 miles of the Ganges River at 2 pice a ton on 1 million tons . . .	50 lacs.
Saving on 800 miles of the Indus at 2 pice on 50,000 tons	4 ,,
Saving on 2,700 miles of other rivers at 2½ annas on 50,000 tons	216 ,,

Saving on 2,000 miles of coast canal at 3 pice on 50,000 tons	15 lacs.
Saving on 3,000 miles of other canals at $2\frac{1}{2}$ annas on 50,000 tons	240 ,,
Saving on 14,000 miles of railway at 2 annas on 20,000 tons	700 ,,
Total .	1,225 lacs,
	or $12\frac{1}{4}$ millions.
Or in 20 years, taking half of this for the average of the whole period .	122 millions.

That is, if grand railways are carried on, we should, at the end of twenty years, have 2,000 miles of main communications, or one tenth of the main lines the country requires, and have saved nine millions. While, if we follow another system, and turn to account what facilities we have for water communication, and then proceed with cheap railways, we shall have the whole of the main lines opened, and have saved 105 millions sterling. In calculating the saving upon each line, I have of course compared it with the kind of transit for which it will be substituted, whether river, coast, or land carriage. Though this must necessarily be a very rude kind of estimate, yet there can be no doubt that it gives in the main a true representation of the case. In its simplest form, the question is, shall we first have eighty miles of fine double railway, or 4,000 miles of good river

navigation? and when we have done what we can with water, shall we have 1,200 miles of fine double railway, or 14,000 miles of cheap single railway?

If, instead of taking hold of a little strip of the country, and setting ourselves to ascertain whether a railway will pay, we take the whole country from the Himalaya to Cape Comorin, and consider what it requires, and how the greatest advantage may be obtained in the least time, there will be no sort of doubt as to the main point, that grand railways will not answer our purpose. No one is more sensible than I am, that complete railways are the most perfect communications, and are invaluable in an advanced country where there is a vast number of people whose time is extremely valuable; and to this we hope India will come in time; but what is most wise in a rich man, is utter ruin to a poor one; and to lay 100 miles of railway, and leave 10,000 miles of trunk lines unimproved, is beyond all possible reach of doubt as great a mistake as could be made. If we want fine railways as soon as possible, the best way to obtain them is to take the shortest course to throw open the country, in order to remove the insufferable burthen under which it now groans, and allow it to put forth its energies. Every mile of railway costs not only what is expended on it, but what is expended also on the cost of transit on the fifty miles of land transit for which as much river navigation might be substituted. Thus, if instead

of spending 10 lacs on the Godavery, the improvement of that line be delayed for twenty years, and ten miles of fine railway executed instead, there would be a loss on only 50,000 tons carried by land from the basin of that river at 60 rupees a ton the 400 miles, of 30 lacs a year for twenty years, or 600 lacs. So that the actual cost of the railways, great as it is, is a mere trifle in comparison of the loss that it causes. And this calculation of 600 lacs in money is a trifle compared with the full amount of loss to this vast tract that will thus remain closed against all the refreshing influences that a free communication through it would inevitably bring in. Who can form an estimate of the mischief thus done?

During the twenty years that it took to throw a network of railways over England, that country had the advantage of a complete system of both canals and good turnpike roads. How totally different is the state of India, and what will be its state during the 200 years it will take, at the present rate of progress, to provide it with railways! But the fact is, it will never be done, while people delude themselves with such railways; they will fancy they are actually supplying the wants of India while they are, in reality, doing nothing in comparison of what it wants.

To return, then, to the question of a canal, or of river improvements for the line from Allahabad to

Calcutta; on the principles now advanced, I would certainly at present throw more water into the river. At 20,000 rupees a mile for the one, and 2,000 for the other, the latter could be done in one-tenth of the time that the former could, and the cost of the whole, 12 lacs, if it produced a saving of only one pice a ton per mile, on 1½ million tons per annum, would be realized in three months, or if the canal were begun at the same time, and finished in five years, the cost of the river improvements would be saved twenty times over before the canal was opened. If the money and labour already expended on the railway had been spent on the river improvements, we should already have 1,200 miles of very fair navigation, and be saving, at the very least, one pie per ton; or suppose 12,00,000 tons for the whole 1,200 miles, 72 lacs a year. Such is the price we are now paying for our finery, because, beggars as we are, we will be as great men in one point as our wealthy neighbours.

Let us first get rid of our incubus by the readiest means, and let in the air and light to the dark interior regions of the country, and then we may sit down and consider how to provide ourselves with the greatest luxuries in the way of transit.

I would now make some more particular remarks on the kind of works which I advocate, only premising that I do not mean to insist on those as the only possible works. On the contrary, what I desire

is, to see many minds exercised on this point; only let them look at the whole subject, and consider what India requires as she now is, and how it may best be obtained. I am satisfied myself, that the means I propose are incomparably more to the purpose than those now in progress; nay, that by their means we shall, in a tenth part of the time, attain to these very objects that are now being grasped at, viz., rapid and luxurious travelling, but if any one can propose still better means, so much the better.

There seems to me, however, very little hope of any plan by which a greater extent of very cheap transit can be obtained in a short time than by improving the rivers. When I speak of the works costing little, it is chiefly with reference to time. The saving effected by speedily getting rid of the present enormous cost of transit, is, as I have shown above, enormously more than any saving in the execution of the works. On a line of land carriage of 100,000 tons a year, the expenditure is 20,000 rupees a year per mile; if this is deferred for ten years, 2 lacs of rupees a mile is lost, while the substitution of a cheap railway for it would only cost perhaps 12,000, and the improvement of a river not 2,000.

Though, as I have said, something may be done in the beds of the rivers, yet in general the first point is to throw more water into them. I have estimated that it can be stored at 2,000 cubic yards per rupee. This estimate is the result of long ex-

perience among the tanks of the Carnatic. Without any remarkable advantage in the site, a bund may be made almost anywhere at this rate, but in many situations, where the form of the ground favours it, thrice this amount may be stored for a rupee. A bund ten yards high would cost in the Carnatic 14 rupees a yard, and if the fall of the country were ten feet a mile, and the water stood eight yards deep at the bund, it would retain 17,000 cubic yards of water for every yard length of bund, with little assistance from the form of the ground. If the fall of the country were less, the quantity of water retained would be proportionably greater. And it is to be observed that in India generally, the slope of the country is much less than in the Carnatic.

It must also be remembered that in choosing sites for tanks to store water for the rivers, we should have the choice of the whole of the upper part of the basins of those rivers. It would not signify where they were situated. In some cases, no doubt it would be necessary to purchase land, but the wildest and most uncultivated parts would generally be chosen.

There are many single tanks in the Madras Presidency that contain water enough alone, materially to improve the navigation of the Godavery, and were our Government to take such a matter in hand, no doubt sites could be found to contain a much larger body of water than any existing tank holds.

What quantity of water it might be desirable to throw into the other rivers, such as the Ganges, I do not know; but of this I have no doubt, that the cost of it will bear no comparison with the benefits, if such an immense traffic is facilitated. If the water at a shallow is 1,000 yards broad, and the current two miles an hour, it would require thirty million cubic yards a day, or 3,000 million cubic yards, to keep it a foot deep for 100 days. This might cost 30 lacs; a very small sum to benefit a navigation of suppose 700 miles, on which a million tons pass annually. The interest of it would be equivalent to one-tenth pice per ton per mile for those 100 days, and probably it would save twenty times as much in the cost of transit. But what is now doing on this line? It is proposed to spend a lac a mile for 500 miles; such a sum would supply 250 million cubic yards a day for 200 days, sufficient to provide a stream 2,000 yards wide, and three feet deep, flowing at two miles an hour, which would make the Ganges, throughout the year, a perfect navigation for steamers drawing five or six feet, besides effectually protecting the country from floods. But there is not the least occasion to go to any expense approaching to this. The cost of fifty miles of railway will certainly give 700 of excellent river navigation. And as I have said before, in the case of the Ganges, something must be done besides the laying a railroad. I suppose it will not be expected that a

double line of railroad will convey two million tons, or *an average* of 6,000 tons a day besides passengers, in which case it might be wanted on some days to convey 12,000 tons and 5,000 passengers. The traffic which cannot be carried on the railroad, must be provided for in some other way. It is finally determined to leave the greater part of the traffic to all the present disadvantages. This is out of the question. Suppose that only half a million tons are left to go by the river from Allahabad to Calcutta on an average of the whole distance, the cost of this, according to the railway advocates' calculations, will be 5,00,000 tons $\times$ pice 9 $\times$ 600 miles = 135 lacs a year. Is this to be allowed, while at least 100 lacs a year of it might be saved by improving the river at a capital cost of perhaps 30 or 50 lacs, or an annual expense of 1½ or 2½ lacs?

I am not aware what the canal from Calcutta to the Ganges was estimated at, but whatever it was, it would not affect my position, because what we want is immediate relief. Here we have to deal with a loss of 100 lacs a year, and if we take a work in hand which will require five years to execute, we ensure a loss of five millions sterling.

The fact is, that the fundamental point in the whole question is *time—the time in which the communications can be improved.*

Let us first take some one line, not one on which there is an extraordinary amount of traffic, as on

the Ganges, but yet one of considerable traffic, such as the line between Madras and Bombay, which may be considered a fair specimen of the ordinary main lines of the country. The present traffic on this line has been ascertained near each end. The total cost of traffic on the Thull and Bhore Ghauts together, as given in the published reports, is about 22,000 rupees per mile per annum. The average near Madras is about 12,000 rupees a mile, for goods only. The mean of the two is about 17,000 rupees a mile; and if this diminishes from the ports towards the interior, till at the centre of the line it is scarcely anything, then the average of the whole will be 8,500 rupees. But it is quite certain that if very cheap and expeditious communications were opened along it, a vast quantity of traffic *now existing*, would be brought by the nearest line to each point of it; traffic, which at present makes for the ports by the shortest routes, and hence we may safely conclude that, of the present traffic much more than the above average would pass along the new communication; perhaps nearly double, or suppose to the amount in all of 15,000 rupees. If, then, the actual cost of transit, including interest, were reduced from $2\frac{1}{2}$ annas ($3\frac{3}{4}$*d.*) to one-fourth of that, or $\frac{5}{8}$ anna (1*d.*), there would be a saving of 12,000 rupees a mile on existing traffic. But I have before argued that in case of such a diminution of cost, there will be at least as much property saved by the convey-

ance of new goods, which could not be moved before on account of the expense; or we may reckon that upon the whole there would be a saving of 24,000 rupees a mile, or on the whole line of 24,000 × 763 = 180 lacs, or 1,800,000*l.* sterling per annum. Now if a new road is carried across this space, at the rate that the Bombay railroad is going on, about twelve miles a year, beginning at both ends at once, the distance will be accomplished in a little more than thirty years. Allowing, of course, that the parts on which the greatest traffic is, are first executed, about one-third of the above sum, or 1,800 lacs, or 18 millions sterling, would be lost on an average during the thirty years. But of course we must reckon upon the traffic increasing (owing to the general improvement of the country) greatly during that time, if, as we hope, a new order of things prevails; and on this account we may fairly reckon the loss from the delay of the work at 25 millions sterling, or 33,000*l.* a mile for the whole period (3,30,000), so that to the cost of a railroad we ought to add this sum with its accumulations of interest, in all, about seven lacs of rupees, or 70,000*l.* If the railroad cost half a lac a mile, it will thus appear that the time in which the work should be executed is of fourteen times as much importance as the cost of the work itself.

And we shall find that it would be better to spend double or treble on any work rather than delay its

execution. Supposing it were necessary, in order to get the communication completed in half the time, to lay out double the money upon it, the account would stand thus:—

760 miles at half a lac	380 lacs.
Interest and working at 4,000 rs. (¼ of present cost) a mile per annum for thirty years. . . .	456 „
Half expenditure on transit on the common roads during that time, as shown above the mile. . .	960 „
Total expenditure in thirty years	1,796 lacs.
760 miles at one lac.	720 lacs.
Interest and working at 4,000 rupees a mile for fifteen years	228 „
Do. for last fifteen years of the thirty.	456 „
Expenditure on transit on common for only half the ten thirty years.	480 „
	1,164 „
Saving	632 lacs.

Or, there would be a saving in the thirty years of six millions sterling, by laying a railway in half the time at double cost. But this does not allow for the gradual increasing traffic, nor for the amount

lost in interest, which would tell in favour of the second calculation very greatly.

But, of course, the real question is, What is the kind of work that can be most rapidly carried across? Let us suppose it were a cheap railway, which should be executed in two years, at an expense of 20,000 rupees a mile, and that it could be worked as cheap as the other, the additional cost of draft on a less perfect road being made up by the diminished interest. The calculation would then be—

760 miles at 20,000	152 lacs.
Working, &c., at 4,000 rupees a mile, for 30 years	912 ,,
Expended on transit by common roads during the execution of the work	62 ,,
	1,126 ,,
Total expenditure by the expensive railway executed in 30 years . .	1,796 ,,
Total expenditure by the cheap one completed in 2 years	1,126 ,,
Saving .	670 lacs,
	or $6\frac{3}{4}$ millions sterling.

Or, in other words, if the cost of the present traffic, including what is brought on to this line in consequence of its improvement, be 24,000 rupees a

mile, and it can be reduced to a quarter of that sum by a railroad, there will be a loss of 18,000 rupees a mile, or 137 lacs on the whole line, for every year the work is delayed; and it would be as cheap, if necessary, to spend a lac of rupees a mile on it, and do it in one year, as it would be to spend 10,000 rupees on it, and do it in ten years. Thus:—

One mile of road.	10,000
Loss by excess of expenditure on one mile of common road during the time of execution (ten years) allowing half for the average . .	90,000
	1 lac.

The question then seems to be, *By what means can the greatest extent of line be opened in a certain time?* And it leaves entirely open the question, What may be the best ultimate kind of communication? This simplifies the matter exceedingly. Upon this view of the case there can be no doubt, that at all events, while such a railroad as is now under execution at Bombay is creeping across the country at, suppose twenty-four miles a year, or even allow 100, it is advisable to execute another work in the meantime, and it would have the important effect of at once giving its full value to whatever portion of the complete work is executed, as it would bring

the whole traffic down to it, just as if the whole main line were executed. What we want then, is, a ready-made railroad, that we can buy out of hand, and which will require little work to put in on the ground. It is evident that, with such a means, wherever a line would pay the interest of the money, we might at once have a railway, and this on any number of lines.

When this point is acknowledged, and the minds of many are turned to discover what will be the most effectual kind of work for our purpose, no doubt many suitable ones will be found. The one I should propose is, for the low tracts simply a series of wrought iron beams supported on cast iron posts, screwed in the ground with Mitchell's patent screw. The beams might be from twelve to twenty feet long. Such beams are now being rolled without difficulty. They should be very deep of course, and the upper surface need not be more than $1\frac{1}{4}$ broad, for I would not think of working these roads at very high speed or with heavy waggons. They would not have to bear a tenth of the weights used on the English roads, and consequently need not have a surface of half the breadth. On the higher tracts, and where low embankments are required, I would lay down one of the new forms of rails, with a broad base, requiring neither chairs nor sleepers. I would allow considerable slopes on these lines, and if, as is generally the case in India, there is a decided pre-

ponderance of traffic in one direction, I would allow greater slopes in that direction than in the other. It would probably be quite sufficient to have gradients of one in 100 one way, and one in seventy or eighty the other. *Cuttings* to a small extent might be made, but I would have no embankments of any height in the first instance, and as the drainage of the country would not be interfered with, no masonry works would be required. The rivers would be crossed by high screw piles; or it might be worth while, in some places, to have narrow masonry piers, which would involve very little work. The iron beams must be stayed across at intervals, to secure the gauge. It would be a question on some lines, whether cast iron or teak posts should be used, but as the former could be got in any quantities, and could always be used in another place, when they had done their work where first erected, they would be preferable in general. From the general state of the surface of the country in India, a very great extent of line could be formed with the above slopes, without any excessive height of posts; and where the country was not so favourable, one of these plans might be adopted: either high cast iron or teak posts might be screwed in to a good depth, and, if necessary, supported by being placed at a small angle towards each other, instead of perpendicular, which with the screw would give immense stability; or a series of masonry piers might be raised, or a

regular embankment be formed, or greater gradients might be allowed for that division of the road, and additional horses or engines used. It must also be particularly observed, that the more difficult country will generally be about the watersheds and furthest from the coast, where the traffic will be the least, perhaps not more than a tenth of that nearer the coasts; so that it is by no means essential to have so moderate gradients there as in the lower parts of the country.

I have supposed that these lines will be worked at a moderate speed. The choice is not between a high speed and a low speed, but between a low speed and none at all. *One thing is certain, we cannot have the complete railroads laid at once all over the country.* The question is, not whether at the end of fifteen years we are to have 15,000 miles of high speed railway, or 18,000 miles of low speed lines; but whether we are then to have 1,500 miles of high speed lines, and 13,500 of common roads; or 1,500 of high speed and 13,500 of low speed railway. What an absurdity it is to insist on either high speed or nothing; to travel 100 miles out of a 1,000 at forty miles an hour, and the remaining 900 at three miles an hour. But this point of speedy travelling is altogether an insignificant point in the present state of things in India, in comparison with cheap transit generally. And further, this plan for quickly covering the country with cheap communication does

not the least interfere with the question of speedy transit, further than that it will immensely assist it, by completing the lines, though imperfectly, years before they could otherwise be completed at all.

I am of opinion that Mitchell's screws will give immense stability to the posts, from their enabling us to insert them into the undisturbed ground, and the only question will be, what depth it may be necessary to insert them. How very little height will be required in some parts of the country is shown by the levels for the Madras and Arcot Railway, which only requires an average height of bank of 4½ feet with gentle gradients. Such a railway would not be very expensive, but the rapidity with which it could be put up would compensate even for a very great cost, if necessary, if, as has been shown, 24,000 rupees a mile are lost every year for want of one. The estimate for a mile may be something like the following:—

	Rs.
176 cast-iron posts, averaging eight feet in length, and weighing four cwt. 35 tons, at 8*l*.	2,800
176 rolled iron beams, 20 feet long, 80lbs. per yard, or five cwt. each, 44 tons, at 10*l*. a ton	4,400
2,400 yards of broad-flanged rail, at 40lbs., 44 tons, at 10*l*.	4,400
Excavation, 16,000 cubic yards, at one anna	1,000

Sundries	3,140
	15,740
Rupees . .	20,000

Such a road should be furnished with very cheap buildings; and if worked at low speed with cattle or very light engines, and with very light loads, ought scarcely to require any repair. What I would particularly insist upon is, that the loads should be so light as not the least to affect the road. One of the most essential points in such works is, that if possible there should be no masonry at all, because it is that which would most retard their execution. If there is only a little earth-work to be executed on the road, and the rest of the expenditure is on rails and things that can be obtained at once, 1,000 miles in one line can be executed in a single season.

With respect to the cost of working such a road, we have the following data:—

The actual expense of draft in England at high velocities is about $\frac{1}{4}d.$ per ton per mile, or $1\frac{1}{2}$ pice. Allowing for these roads having steeper gradients on the one hand, and on the other being worked at a lower speed, we might take the expense at the same as at home; but as labour and materials are so much cheaper in this country, we may on this account reckon that the cost will certainly be less than in England, or suppose $\frac{1}{8}d.$ or one pie.

Again, the cost of conveying by bullock-carts on a good-made road here is about one anna, or 1½*d.* per ton per mile, exclusive of carrier's profit. The cost of bullock-draft on such a railway would be reduced to about one-sixth, on account of the diminution of resistance; and this would give therefore two pice or ¼*d.* per ton. And again, from results already obtained in this country, we may safely calculate on steam-power being only half the cost of that of bullocks on a railway, which would thus reduce the cost to one pie, or ⅛*d.* per ton per mile, the same as obtained by the former calculation. Upon the whole, I think we may take one pie as the cost of draft.

And the calculation for working this railway might then be—

	Rs.
10 per cent. interest on say 20,000 rupees	2,000
Management	100
Repairs	100
Sundries	300
	2,500
which divided on tons, 144,000, gives per ton	3½ pice
Draft	1 pie
Charge per mile	4½ pice

or about one-seventh of the present cost of transit.

In the previous calculations, I supposed that the charge was one-fourth of the present rates.

But here I have reckoned as if the whole of the charges of the railroad were paid nearly equally on the travellers and on the goods; whereas probably almost all should be paid by the travellers, and the goods charged with *little* more than the bare actual expenses, in order to enable us to get the utmost advantage from it.

Thus if the present travellers are 1,000 per day only, and cheap and comparatively rapid conveyance increased them four-fold, the total number conveyed per annum would be 14,60,000, and the charge for each on account of interest, &c., if paid entirely by them, would be only one-third pice per man per mile; and the total charge for the poorest class of passengers might thus still be under one pie per mile, or ⅛*d.*

Respecting these numbers we have the following data:—

On the Bhore Ghaut . . 2,84,000 per annum,
or 800 per day.

We have no other statistics of passenger traffic on this line; but the following show how enormous it is generally in the country:—

On one of the main roads in
Tanjore, taken in 1837 . . 1,289 per day.
On another . . . . 1,550 ditto.

These were not in the immediate neighbourhood of any great town. Now, if men travel in these numbers without any one facility, having to walk at twenty miles a day, so that on a journey of 200 miles and back they must be absent from their work and their families at least three weeks, we cannot doubt that if the same could be done in two days, and at a less expense than it would cost a man to walk, the intercourse would be immense, and more than quadrupled.

I have myself no doubt that the passengers will abundantly pay the interest, &c., for the railway, and that the goods may be carried at the bare cost of transit. In England some things are carried now at ½*d.* a ton, or four pice, at their comparatively high speed, and including some profit. If in this country they can be carried at even 2*d.*, or one-fifteenth of the present cost, it is difficult to estimate what the increase of goods traffic will be. When a ton can be carried 100 miles for a rupee, a very trifling difference in the market price at two points will be sufficient to cause a thing to be transferred from one to the other. Thus, if grain be worth 30 rupees a ton, a difference in value of six per cent., or 2½ seers in forty for the rupee might be sufficient to give rise to a trade between two places 200 miles apart. The coarsest goods,—fire-wood, building materials, straw, &c., would be carried hundreds of miles. In fact, we could not be surprised if the goods traffic in-

creased ten-fold, as it has nearly done through the Paumbam Pass.

If we allow the total cost of draft, interest, &c., to be one-fourth of the present cost as first assumed on such a road as this, and that it is executed in two years, the comparative results of this and a complete railway laid at the rate of fifty miles a year (or double the rate they have been working at Bombay) at both ends, would be thus calculated:—

760 miles, at 20,000 rupees . . .	152 lacs.
Cost of transit at ¼ present rate, or 4,000 rupees a mile, for 15 years	456 „
Total expense . .	508 lacs.
760 miles, at 100,000	760 lacs.
Cost of working half of it at ¼ present rate for 15 years	228 „
Ditto of one-half at present rate .	912 „
	1,900 „
Loss by waiting for the complete road	1,392 lacs,
	or 14 millions sterling nearly.

And if we suppose that the traffic would be increased four-fold by the improved communication, we must add to the above enormous difference all the loss that would be occasioned by the non-transporting of

three-quarters of the goods for fifteen years instead of two; and to this, again, the much more incalculable loss arising from the postponement of the passenger traffic: the calculation, also, does not include loss of interest.

This will help to give us some notion of what we are paying for the large railroads. By the above calculation alone, this road would cost two lacs a mile above what it appears to do, and in point of fact at least four lacs a mile, or more in money, allowing for the delay in the additional traffic, and this besides what cannot be calculated in money. If all the above calculations require great correction, they will still leave no possible room for question as to the main point, viz., *that nothing can compensate for the loss of time in opening the country.*

Even if a railroad that could be laid in a year, should cost four times what I have calculated, or even ten times, there can still be no question that it ought to be done rather than wait.

I do not pretend to say that these railways are the best possible means of accomplishing our object; there may be much better. What I *chiefly* want to show is, first, what is wanted, viz., speed, not in travelling on the railways or canals, when executed, but in executing them; and secondly, that it is quite possible to have a kind of communication that can be quickly executed.

What I propose would have these advantages:—

1st. It could be executed at any rate of speed. England could provide rolled and cast iron in any quantities. At the rate of 100,000 tons of cast iron, and 130,000 tons of rolled iron per annum, 1,000 miles a year could be executed, and the whole system of main roads, 15,000 miles, might easily be executed in five years. Supposing 1,000 rupees a mile were spent on the ground, it would only require an expenditure of 30 lacs a year, which could easily be managed, if fifteen main lines were begun at once, at both ends, so that one lac would be spent annually on each portion of the undertaking. Thus, about 200 miles of the most important part of each main line would be finished each year; or else only five of the most important lines might be begun at once, and 600 miles of each would be finished every year.*

* We have happily some instances already to show the rapidity with which works can be executed in India. The two masonry weirs across the Colleroon, one 800 yards long, and the other 680, were both completed in the same three months. One branch of the Godavery weir, 960 yards long, was carried across in a fortnight, to such a state of completion as to allow of the water going over it. The Nuggaram aqueduct, over a branch of the Godavery, 800 yards long, and containing forty-nine arches of 40 feet, built in a tideway, and the last arch keyed within four months from the time of commencing to make bricks. This work is 28 feet broad, and it was ready for the water to go over it in about seven months from the same time. It is built with the crowns of the arches 7 feet

2nd. As any portion of the line was laid with a more complete work, the former could be taken up and placed on another line at a trifling cost. If worked with light loads, it would last for ever, or at least for so many years as would amount to much the same.

3rd. By laying down these lines we should leave ourselves quite at liberty to pursue further plans at leisure; and we should have this very great advantage, that we should feel our way, and in laying the permanent lines we should have the experience of these temporary ones to help us to judge whether

below the surface of the water in the river; and before the side walls could be finished, a tremendous flood occurred, which went two or three feet over all, and entirely submerged the work for five days, but without injuring it. Great precautions, of course, had been necessary to secure the foundation, under such circumstances, in the bed of a river consisting wholly of loose sand. Under Providence these precautions were completely successful. And it is highly encouraging to find, that so far from these sandy rivers being almost insuperable obstacles (as the same has been supposed), a work can be constructed there which will allow of the river going over the parapet walls without injuring it. This, as well as hundreds of other works of various kinds, bridges, aqueducts, rivers, sluices of all descriptions, &c., have been built in rivers in the Madras Presidency, where there was not a vestige of anything but loose sand to an unknown depth, and have been standing for many years; and probably not one of them has foundations ten feet deep; in general they are six or eight.

they were quite the best line of country that could be adopted.

4th. They would be of the greatest use in the execution of more complete works.

5th. If any sections of the line contained very heavy works, that need not delay the opening of the other parts of the permanent line, as such parts of these lines might be worked in the meantime; such a work, therefore, as the ascent of a ghaut, or a long tunnel, might be executed on the best plan, though it took many years to finish it.

6th. Such a line might be put up anywhere, where it would for the present be of use, even though it were probable or certain that it would not ultimately form a portion of any permanent line.

7th. If it were found to increase the traffic very greatly, there could be no objection to adding a second line, though both were to be eventually superseded.

8th. It must be remembered that it is hardly possible for us to judge what changes may take place in consequence of these powerful agents being brought to act upon a country hitherto so neglected. Hitherto, everything has been cramped and forced into certain places and lines, by natural obstacles; but when the natural resources of the country are set at liberty by the opening of the country generally, so as in fact to remove natural obstacles, most unexpected changes may take place. One change is almost certain, that the minor ports will all become places of extensive

foreign trade, by the settlement of European merchants at them. And thus much more of the trade will go from the interior to the nearest ports than at present. And certain spots which are the most suitable for certain kind of produce, but are at present unavailable on account of the cost of transit, and their inaccessibility to the European merchant or manufacturer, will then be applied to the purpose for which they are naturally suited. For instance, how many places 200 miles from a port, are now not available for sugar cultivation on account of the transit costing *3l.* a ton, which would be highly profitable plantations, if the transit cost 10*s.* These lines of railway would soon bring such things into view, and they might materially modify our views with respect to permanent lines.

9th. By no means an insignificant result of this plan would be the considerable demand that it would make both on England and on India for one of their most important products and manufactures. An annual consumption of 20,000 tons of iron for many years, would have some very perceptible effect on the iron trade.

We may now consider some objections that may be made to this kind of road. Probably the first will be, that a raised road will be more dangerous than an ordinary one. There is no doubt that there will be some little additional danger to the travellers, but it will be very little. In the first place, I propose that they

shall be worked at a much lower speed than the complete roads. It is certain, that there would be scarcely any accidents at low speed; almost every one that now occurs is caused by high speed; secondly, I would work goods and passenger traffic at the same speed, so that the chances of collision would be almost entirely removed; thirdly, I cannot but think that, upon the whole, in this country, there would be less loss of life on a road, of which a great part was raised on posts above the level of the country, than on one which men would be frequently crossing, or even walking along it. And some sources of danger to the passengers would thus also be removed. Indeed, considering the apathy of the natives, we must expect many accidents to happen to stragglers on the roads if they are accessible. At the Godavery works one man actually walked straight up against a loaded waggon coming towards him at three miles an hour, and was knocked down backwards, the carriage passing over him as he lay between the rails. One thing is quite certain, that the danger on such roads, worked at eight miles an hour, will be much less than those on the present railroads in England, worked as they are at thirty or forty miles an hour, and with trains running at different speeds; and as people do not object to run the risk there, the smaller risk cannot be an obstacle here. If thought desirable, planks might be laid between the rails, resting on the cross stays which

connect the rails, in order to enable persons to stand on the road; but probably it would be better if persons could not pass on foot along the line of the road, excepting on the ground, along which a path might be made. At rivers and channels, a line of planks could be placed outside the posts, supported on brackets below the level of the rails, so as to form a foot bridge. But all such minor points will soon be arranged when such a line is laid. In other respects, such a road would be exceedingly secure. The beams would be fixed in a deep *notch* cast in the post, and secured by a horizontal stay, the ends of which pass through both the beams and the posts, having nuts screwed on outside the *latter*, to hold them against shoulders on the stay. I do not know what further objection could be made to such a structure.

I have before spoken of the breadth of the top of the rail. On the present rails, which are only 2½ inches broad, engines of thirty tons and waggons of seven tons are run, so that there can be no sort of question that a bearing surface of 1 inch or 1¼ inches, will be quite sufficient for such a road as this, with loads of one ton.

Instead of iron, it is evident that both posts and beams might be of teak, which would cost probably 8,000 rupees a mile less. A plain square bar of 1¼ inch iron might be laid on the timber, and secured by deep screws, as in America. Only I would make

the difference of a square bar, instead of a broad thin one, which they use there. The difference between a bar of 5 inches and one of $1\frac{1}{4}$ inch thickness is immense; and the trial, on the fastened screws, would be nothing with the latter, compared with the former. A great mistake was made at the Godavery works, in making all the railroads with bars only a half inch thick and two inches broad for five ton gross loads. Square bars of the same weight would have been much better. They also give sufficient height for the *flange* without cutting away the wood. Probably the broad thin bar was used in America for the same reason as it was at the Godavery; it not being considered, that if engines of thirty tons could run on a surface of only $2\frac{1}{2}$ inches in breadth, there could be no necessity for such a breadth for light engines.

If it is still objected that we *must* have high speed, the answer, so far as the present question is concerned, is, "Have it by all means as soon as you can;" but this does not alter the case. What is here proposed is, something to supply the place of common roads whilst these high speed railways are under construction. Because you insist upon going along the first 100 miles at forty miles an hour, there is no necessity for our going along the next 500 at three miles an hour.

The present high speed railways are most important works, but, like everything else, they may be pro-

portionably mischievous, if perversely used. Assuredly, up to this time, they have done nothing but mischief in this country. They have only made people suppose that they were doing something, and have thus lost many years, and prevented anything being done which would really throw open India. It is just as if a man took wheat out of a bushel grain by grain to eat, and so died of starvation while he was constantly employed in eating. Suppose that in ten years from the commencement, there were in all 500 miles finished (and one of them, too, on the present cheapest line of transit in India), half a million a year might be saved to the country out of the 20 or 30 millions that want of communications now costs her. Whereas, within the same ten years, the whole of India might, with the greatest ease, have been pervaded by lines of cheap transit.*

* As these sheets are passing through the press, the description of a railway laid upon the common road, in the Champs Elysées, Paris, appears in the *Illustrated News*. The results expected from this work are, that two horses will be able to do the work of fifty, at an average speed of 18 miles an hour, at a cost of 30,000 francs (1,100*l.*) per mile for its construction, and with a reduction on passenger fares from 30 to 15 centimes. If we could get only half these results for India, at the same cost, the advantages would be incalculable. Shall we secure them, or shall we spend millions in works that will give us only limited benefits at an indefinite period?

CHAPTER III.

Speed.

ONE of the fundamental points to be settled before we can determine upon a system of communication is, the value of time in the transport of goods and passengers. Speed, like everything else, may certainly be bought too dear; and one thing is certain, viz., that increase of speed, whether by land or by water, by railways or roads, involves an increase of expense much more than proportional to the gain of time. In fact, the increase of cost in high speeds is enormous; and both poor individuals and poor communities will find rapid transit so much beyond their means, that in order to purchase it they must impoverish themselves so much as to greatly retard their progress. They may obtain rapid travelling in an isolated case, but it must be at the cost of greatly delaying the attainment of this object generally. If a poor man aims at having the means of keeping his carriage, and travelling fast whenever he likes, he must not, while he is still poor, spend all his spare money in buying a carriage.

The question therefore is, what the cost of speed

is; and in the case of any particular country, whether it can yet afford it? The cost of speed in water transit can be pretty well calculated. A double velocity through the water produces a four-fold resistance, and therefore it takes four times as much power to convey anything a certain distance at a double speed. But there is a further consumption of money caused by the necessity of having in operation, a power proportioned to the additional speed as well as the additional resistance. A boat, going at a double speed, meets with a four-fold resistance, but if it be necessary that the power to overcome this four-fold resistance should pass through a double space in a certain time, it therefore requires eight times the power to be in operation, though only for half the time. Further, the machine which produces this power must itself be carried, and its weight and bulk must increase with the increase of power. Besides this, there are various other minor sources of waste in using high speeds, so that we may reckon, that double speed requires afloat at least a six-fold expense, besides the inconvenience of having to provide a greater capital. That is, a man may travel at five miles an hour at one-sixth of the cost at which he can travel at ten, taking interest, consumption of materials, and everything else into the calculation. Besides, that he would have to raise about a six-fold capital, or perhaps much more, is of course a separate question; he might be able to

afford the additional current expense, but be quite unable to raise the required additional capital at all, or at least not without so crippling himself in other ways as to render it upon the whole unadvisable. If a merchant has credit, he of course considers how he may apply that amount of credit so as to produce the greatest profit.

In land transit, it is now clearly ascertained, that this increase of cost in increased speeds, follows much the same law as afloat. On a common road, the horses require so much of their power for moving themselves at higher speeds as rapidly to absorb the greater part of it, leaving only a small portion to produce useful effect, and at the same time the resistance rapidly increases The same also is the case with railroads. The resistance increases, and a large portion of the power of the engine is absorbed in moving itself. But besides this, in the case of railroads there is an enormous increase of *first* cost, in constructing the road. For high speeds a most perfect apparatus is required; enormously heavy engines, and, consequently, rails of immense weight, most secure fastenings, &c., and also gentle slopes and easy curves, at a cost in excavation almost incalculable in some instances. It is well known that the effect of a blow on the rails increases as the square of the velocity, and hence an engine of double weight, and moving at a double speed, strikes the rails with eight times the force. There is also another

source of increased expense in the case of a railroad. If a high speed is required when the traffic is considerable, a double line is unavoidable. If there be only a single line, either the first train must start at long intervals, or all trains must travel at the same speed, and that a moderate one, because the great bulk of goods being of small value would not bear the cost of moving them at a high speed. Thus, the capital required for a high speed by railway would be immensely increased; and the high interest consequent thereon would also greatly increase the actual cost of transit, and therefore whatever means we use, we must pay very highly for speed.

The question is then reduced to this, Are our circumstances in India such as to render it advisable for us at present to enter upon a general system of communication that will afford us a very high speed?

Let us first try and form some judgment of the actual cost of high speed on a railway as compared with low speed by the same means of transit. It is said, that the present Calcutta railway will cost per mile for a double line 1¼ lacs, or 12,500*l.* The interest of this, at a little above the present Government interest, suppose six per cent., will be 7,500 rupees a mile per annum, or 24 rupees a day. The goods traffic on this line is immense; some accounts say two million tons a year. Supposing that the railway could work below the cost of the river transit,

we have no means of ascertaining what amount of goods it could convey. If we suppose that while worked at high speeds for passengers it would convey 2,000 tons a day, the interest, if borne entirely by the goods, would be $2\frac{3}{4}$ pice per ton ; and if to this be added the English rate of cost for working the roads, viz., 2 pice or $\frac{1}{4}$*d.* per ton, it would make the total charge $4\frac{3}{4}$ pice. The prices by the river are at present about 4 pice, including interest and insurance ; by a perfect common road, 8 pice, by a less perfect metalled road, 14 pice, by a common unmade road, 3 annas, and by a canal half a pie. Supposing that half of this interest were paid by passengers, that portion chargeable on goods would be $1\frac{3}{8}$ pice, and the total charge would then be $3\frac{3}{8}$ pice per ton, or perhaps 3 pice, allowing that the cost of draft, &c., will be less than in England, or $1\frac{5}{8}$ pice. Let us now suppose the railway worked at a low speed, such as eight miles an hour, in which case all the trains would travel at the same speed, so that a single line of rails would be sufficient ; and as only very light engines would be necessary, light rails might be laid, and a vast reduction would be made both in the cost of construction and in the wear and tear, &c. ; and such a line might no doubt be laid at $\frac{1}{10}$ the cost of the other, or 12,500 rupees. The interest, then, $2\frac{1}{2}$ rupees a day, being divided as before, between the travellers and the goods, would be $\frac{1}{8}$ pie per ton, and the cost of transit, including

wear and tear, would be reduced to probably one pie, the total charge being $1\frac{1}{8}$ pice, or $\frac{1}{18}$ less than for the high speed, which is equal to 10 rupees a ton per 500 miles. This is calculating on an amount of traffic three times that on any railway in England. With 300 tons a day, which would be a large traffic, the difference in amount of interest alone would be $8\frac{1}{2}$ pice, or as much as the whole cost on a good common road, and probably fifteen times as much as on a canal.

But we must see what the charge upon travellers would be to make up half the interest, or 12 rupees a day for the high speed. This brings us to the main point of difference between this country and England as respects quick transit, viz., the insignificant proportion of rich travellers here. The number of first-class travellers, that is, of Europeans and natives who can afford to pay very high rates, is extremely small. The number who travel in Bengal and the N. W. by steamers and horse carriages, is perfectly insignificant in respect to the employment of a railway. We may form some idea of what number of first-class travellers, at certain rates, there would be, by considering the comparative state of things in India and England in this respect. The cost of travelling in England to first-class passengers is about $2\frac{1}{2}d.$, or $1\frac{2}{3}$ annas per mile, and allowing the value of money to be six times as great in this country (by the comparative cost of food and labour),

this will be equivalent to about one-third of an anna, or 4 pice here. If this rate were charged, would there be as many first-class passengers as in England? First, the proportion of rich in India to the whole population is immensely less than in England. You see more wealth in travelling one mile in the latter, than in travelling 100 in India. So that on this account the number of first-class passengers would be perhaps scarcely one-hundredth of the number in England, which, by Dr. Lardner's statement, was, in 1847, 157 a day on the average of some of the principal railways, and 360 in the line of greatest traffic. But this was not the number travelling over the whole length of the roads, but the total number of travellers. The average distance travelled was 40 miles; and the total length of road and branches 438 miles, so that the average number of first class passengers, for the whole length of the roads, was only thirty-three per day. But the greatest amount of travelling of this class was on the Eastern Counties railway, where it was equal to sixty-eight passing over the whole length per day.

But, secondly, the number in India generally will be greater in proportion than in England, because each great line of railway will affect a much larger population; thus each of the six lines of railway radiating from London accommodates on an average one-sixth of the population of the United Kingdom, or nearly four millions, but the Ganges line will

connect about 60 millions with Calcutta. This is a most material point to be considered in comparing traffic in India with that of England, where any particular line of road connects only a comparatively small number of people with a port or a market. Thus, notwithstanding the imperfect communication of the Ganges, it has an amount of traffic in goods on it far exceeding any line in England. On this account, we may reckon that other things being the same, the number of first-class passengers would be perhaps ten times as great as in England. At present, the total number of all that could be called first-class passengers, that is, those travelling by steamers, and by palanquin and carriages, seems to be, by the railway pamphlets, about nine by the former, and thirty-three by the latter, or forty-two in all per day, or two-thirds of that on the greatest passenger line in England. But they pay about five annas, or $7\frac{1}{2}d.$, per mile, three times what is paid in England, or, proportionally to the value of money, eighteen times more. The great reduction of time and cost resulting from a railway would undoubtedly increase the number very greatly; but the question is, not how many *could* pay first-class fares, but how many would prefer them to second-class ones. If there were first-class trains travelling at thirty miles an hour at a charge of two annas, or $3d.$, per mile, and second-class trains at ten miles an hour, charging three pice, or $\frac{3}{8}d.$, the number travelling by the

first-class trains would bear a very small proportion to the others.

Let us consider what would be the consequence, even in England, if first-class passengers were carried at 1*s.* 6*d.* a mile (which would be in due proportion to 3*d.* in this country), although the proportion of wealthy people there is at least 100 times what it is in India, and although, from the different state of things there, people so much better understand the value of time. Perhaps ninety-nine out of 100 natives would rather pay eight rupees for travelling 400 miles at ten miles an hour, than fifty rupees for a speed of thirty miles. And to obtain this high speed for so very small a proportion of the traffic, the whole road must be constructed at such an enormous expense as to entail a high rate of charge for goods and $\frac{99}{100}$ of the passengers, and a low profit to the shareholders. In this country the loss by time both on the great body of travellers and on goods, that is, the loss arising from the difference between five miles an hour and forty, is most insignificant. A ton of cotton, sugar, salt, and grain, is of the value of 15*l.*, 12*l.*, 3*l.*, and 3*l.* respectively; and these would form the great bulk of the traffic. If we take the average at 10*l.*, the interest on this (at 10 per cent.) during a journey of 500 miles at five miles an hour, or four days, would be only five pice, or $\frac{5}{8}$*d.*, and the saving by carrying it at forty miles per hour would be only seven-eighths of that,

or $\frac{1}{120}d.$ per mile, while the difference between the cost of conveying goods on a first-class railway and a cheaper one would perhaps amount to as much as from one to eight pice per ton. And so with passengers: taking their time as worth 50 rupees a month (corresponding with 360*l.* a year in England) —and a very small portion of the population have incomes approaching to that — 3½ days would be worth to them six rupees, which, saved in a journey of 500 miles, would be equal to 2½ pice per mile.

The great difference between England and India in this respect has certainly not been considered in planning the railways. Both the proportion of wealthy people whose time is of considerable value is prodigiously less than in England, and also the average value of goods carried is very much less. The fact is, that while a very high speed in a country so wealthy and so far advanced as England is of the very greatest importance, it is in a poor country like India very secondary to cheapness. It is just the same with individuals. If a poor man insists upon travelling quickly before his circumstances admit of it, he may remain a poor man all his life; but if he will be content to economize in this as well as other things at first, he may in time be able to travel as quick as he likes.

But this is comparatively a very insignificant part of the question. The main point is, that in thus aiming at a very high speed at once we certainly

delude ourselves completely, and lose the very thing we are aiming at. The advocates for high speed say, "Let us have a thoroughly good speed *at once;*" and then they proceed to attain their end by laying down in one corner of India a few miles of their grand railroad, along which you may travel your first stage at thirty miles an hour, and then continue along the remaining 1,000 miles of your journey at three miles an hour, if the monsoon permits you to move at all. They have laid ten miles a year at Bombay, so that ten years hence, if a gentleman wanted to go from thence to Calcutta, he might go the first 100 miles in three hours, and the remaining 1,200 in seventeen days, travelling night and day; or his average speed would be 3¼ miles. The extent of the spaces for which we have to provide communications is totally lost sight of, and in consequence of this the whole system is without a foundation.

No doubt this is greatly owing to the system having been planned chiefly by men full of English ideas. There, by the time a man has laid fifty miles of railroad from a port, he has arrived at what may be called the traffic-shed of the country, the point from which he finds the traffic moving to the opposite coast of the island; but from Calcutta to Lahore is 1,300 miles, and even from Bombay to the centre of the peninsula is 400 miles. In England there are 5,000 miles of railway, or about one to twelve square miles. Taking the area of India

at a million and a quarter of square miles, it would require in the same proportion 120,000 miles; and allowing only one-sixth of this, there will be at least 20,000 miles of main communication required to open India; and 4,000 will be required merely to connect Lahore, Calcutta, Bombay, and Madras, even without a line from Madras to Calcutta direct; so that if railroads were commenced at all the four points at once, and carried on, as at Bombay, at the rate of ten miles a year, it would take 100 years merely to lay these few lines, which would have a very small effect upon the whole traffic of India. But only two of these are yet begun. In point of fact, as to really and effectually opening India, we are doing nothing, and indeed worse than nothing. It is a mere delusion, because it makes people imagine that they are doing what has to be done, and thus prevents them setting about anything in earnest. If the construction of a few hundred miles of grand railroad in the course of twenty years so blinds people as to prevent anything effectual being done to open India, it will, instead of a blessing, be the greatest curse which in the present state of things the country could suffer.

Supposing that speed and nothing but speed were our object, which would most effectually promote it? to lay down 1,000 miles of railway at 5,000 rupees a mile in five years, or 170 miles at 120,000 rupees a mile? In the one case, we might travel at the end

of five years over 170 miles in less than five hours, and over the other 830 at three miles an hour, or in twelve days; and in the former, we might travel over the whole 1,000 miles at ten miles an hour, or in four days. Even if our object be to obtain speed alone, the question is how we may throw open the whole country most rapidly. For this purpose, 20,000 miles of good common road, to be travelled at seven miles an hour, and costing 5,000 rupees a mile, or in all 1,000 lacs, would be of immeasurably greater value than 800 miles of first-class railway at 120,000 rupees a mile. The former could give an average speed through the country of more than double the other. Speed is, indeed, what is the most urgently wanted, but it is speed in forming communications, not speed in travelling upon them. If indeed it were possible to lay first-class railways at the rate of 2,000 miles a year, this part of the question would be altered; but, I suppose, everybody will acknowledge that this cannot be done, or at least, will not; and even if it were, still 50,000 miles of cheap railway could be laid with the same means, in the same time, and would be of incalculably more value.

Nothing can be more delusive than thus to carry on a work which will take hundreds of years to accomplish, and to imagine that we are really gaining our object. What is the use of going a hundred miles at the rate of thirty miles an hour, if we must

then go on at three miles an hour over thousands of miles? Surely, it is evident, that even if our only object were speed, another plan must be pursued. How much more so, then, when speed is not our main object by any means, but cheapness is incomparably of more importance. It must be remembered that, in this matter, almost all who are engaged in planning such works, are liable to be under a bias. They cannot help feeling how agreeable it would be to themselves to travel at high speed; and so to give a very undue importance to this point. Even a merchant will be very apt to think more of his own travelling quickly, than of obtaining his thousands of tons of goods at a lower price, and to misjudge the relative importance of those two things. I do not mean to deny that high speed is a very desirable thing, or that it should be kept in view; but I do say, that if it be purchased on a few hundred miles at the cost of keeping the great body of the country without improved communications for an indefinite period of years, it is manifestly purchased too dearly: and that those who are pursuing the system are undoubtedly defeating even their own object.

But now, let us see how this proceeding affects the welfare of the country in the cost of transit, and the stoppage of intercourse. Let us first compare it with a system of common roads. The common cost of transit in the country where there are no made roads, is, in the practicable season, from two to three

annas a ton per mile; with the incalculable disadvantage of the traffic being almost completely stopped during three or four months in the year. Allowing even a trifle for the latter, we may fairly reckon the average cost of transit at three annas or $4\frac{1}{2}d$. Of the effect of good common roads we have now proofs in different parts of the country. On the grand trunk road of Bengal, the cost of transit has been reduced to eight pice or $1d$. On the great western road from Madras, it is a little more than one anna or $1\frac{1}{2}d.$, but that road is not yet by any means in complete order, and the price will undoubtedly fall yet. From these examples, we may take the cost on a thoroughly good common road at nine pice, or one-fourth of the present cost, or the saving in transit will be $2\frac{1}{4}$ annas, or $3\frac{1}{4}d.$ per ton per mile. As to the cost of such a road: the grand trunk road cost about 8,000 rupees a mile; from the western road from Madras, about 7,000 rupees (a badly planned road), and others in Madras have cost 3,000 or 4,000; we may, therefore, take the cost generally, through the country, at about 5,000 rupees. The grand trunk road is a far wider and more complete work than would be necessary on an average. A mile of first-class railroad may be taken at 120,000 rupees. This would then make 24 miles of first-class common road. The cost of working a railroad seems to be strangely estimated for this country. Mr. Chapman hopes that it may

be worked at $2\frac{3}{4}d.$ a ton, including interest, or $2\frac{1}{2}$ times as much as common roads are now worked at; a strange sort of improvement, by the way, and perhaps scarcely worth paying 1,20,000 rupees a mile for. In England, the actual cost of working at considerable speed is $\frac{1}{2}d.$ or $1\frac{3}{8}$ pice a ton; and in this country it would certainly be less, or suppose one pie, or $\frac{1}{6}d.$ To this must be added the cost of management, which, in this country, will be very moderate. There is no necessity for here going into this matter particularly. Perhaps the whole cost, inclusive of interest, will be four pice; it cannot be very much less. The railway men estimate it much higher. But let us calculate the effect to the country of 1,20,000 rupees spent on either one mile of railway or twenty-four of common road. Supposing, then, a traffic of 200 tons a day, and the interest to be ten per cent., we have the following calculation.

Present cost of transit.

	Rupees.
60,000 tons per annum 24 miles at 3 annas	2,70,000

Present cost of transit in a good common road.

60,000 tons 24 miles at 9 pice	67,500
10 per cent. on 1,20,000 rupees. . .	12,000
Say	80,000

Repairs and management at 500 Rs. a mile	12,000
	92,000
Annual saving on 24 miles	1,78,000

Cost on one mile of railway and 23 of unmade track.

	Rupees.
60,000 tons one mile at 4 pice	1,250
60,000 tons 23 miles at 3 annas . . .	2,58,750
10 per cent. on 1,20,000 rupees. . .	12,000
	27,21,000
Annual loss by the railway	2,000

This is really a fair representation of the different effects upon the country of spending 1,20,000 rupees on one mile of railway or on twenty-four miles of road, so far as many main lines are concerned. To counter-balance this enormous loss, we have the following difference in speed. Of course, there is no more reason for not working a common road by relays of bullocks, than there is for not working a railway continually. If a company worked a common road, they would work day and night by relays; or at least, at the rate of fifty miles a day for goods, and passengers could easily travel at eight miles an hour, or 200 miles a day. By the railway, goods would travel 400 miles a day, or nine days would be saved in a journey of 500 miles. This, as

has been shown above, would, considering the low value of the great mass of goods in this country, be a very small item comparatively. The difference in time to first-class passengers would be about one day and a half for a journey of 500 miles ; but, as before stated, the proportion of travellers in this country to whom this would be any great object is, and will for some years to come, be exceedingly small. Now, the question is, whether this speed is worth purchasing at the enormous cost of about 8,000 rupees a mile per annum, where there is a traffic of 200 tons a day ; or in the 20,000 miles of main road supposed to be required in India, it would be 1,600 lacs, or 16 millions sterling a year. Can anybody who knows anything at all of India, or indeed, of the subject of communications generally, doubt for a moment which would be the most beneficial, 800 miles of railway or 20,000 of common road ? The same capital that would do the one would do the other. Who can question which would be preferable to do at present, whatever might be done ultimately ?

We have thus considered the question with reference to the benefits to the country. We may next examine the matter with reference to the investment of capital. Let us suppose a company formed with a capital of a million. They may either form with this, say in five years, eighty miles of railway, or 2,000 miles of common road. The total cost of

conveying 60,000 tons 2,000 miles, at 8 pice, or 1*d.*, would be 50 lacs.

The cost of carrying the same at present, at 3 annas a ton, would be	225 lacs.
The total saving	175½ ,,

If only a fourth of this were taken as toll, leaving three-fourths, or 132 lacs, clear benefit to the community, there would remain a difference of 45 lacs for the profit of the company, or 45 per cent. on their capital. The community would also have the immense advantage of a regularly organised system of conveyance by a company, goods being carried fifty miles a day instead of ten miles, as at present, and first-class passengers 200, instead of seventy miles per day.

On the eighty miles of railway, the results would be as follows:—

Cost of conveying 60,000 tons eighty miles, at 4 pice.	100,000
Do. do. do. 3 annas.	900,000
Saving. . . Rs.	800,000

If half of this were taken as profit, the return on the capital would be two lacs on 100, or two per cent., and the saving to the community would be six lacs.

Or, the comparative results of the investment on the two works would be as follows:

Profit to shareholders on one million expended on 80 miles of railway.	2 per cent.
Do. in 2,000 miles of road. . .	40 ,,
Annual saving to the country by the railway.	6 lacs.
Do. from the road.	137 ,,

Such would be the result so far as goods are concerned. The number of first-class travellers is at present so utterly insignificant as clearly to show, that unless the rates be greatly lowered, very few indeed of that class will travel by railway. There will be a vast number of other passengers if carried at very low rates, but certainly not otherwise. Perhaps the payments from passengers might be,

50 1st class a day, or 15,000 a year, at 2 annas per mile.	1,875
200 2nd do. at half an anna. . .	1,875
2,000 3rd do. or 600,000 at 2 pice.	6,250
Gross receipts per mile	10,000

It must be observed, that these rates are *3d.* for the first class, equivalent to *1s. 6d.* in England; *¾d.* for the second, equal to *4½d.* in England; and one-fourth for the third, equal to *1½d.*, so that it supposes a proportionally much higher rate of charge in a much poorer country. Yet the profit from this

would not be great; if the actual cost of transit were one-half of this, it would leave 5,000 rupees a mile, or five per cent. for profit on passengers. I do not go into this more particularly here, because this is quite enough to show that the profits could never approach to those on the same money invested in common roads. If the whole of the money paid by passengers on a railway were profit, it would still be trifling compared with the profit on a common road, as I think is clearly shown by the above calculations. The return of capital invested on first-class railway, as compared with that laid out on common road, cannot therefore stand five minutes' calculation.

We will now proceed to compare a first-class and a cheap railway. A cheap railway, with a gauge of three or four feet, light rails, without sleepers, sharp curves, considerable gradients, and timber viaducts, fit for working by horses and bullocks, or with light engines at very low speeds, may be constructed generally throughout India for 6,000 rupees a mile. Such a road could be worked at two pice a ton per mile, or one-fourth the cost of working a first-rate common road. Mr. Chapman, indeed, in his book, estimates the cost of working such a road at three annas per ton per mile; but I suppose few readers would require me to confute, step by step, several pages of argument which end in the conclusion that a cattle railroad cannot be worked under three annas (4½*d.*), or four times the cost at which the grand trunk common

road is now actually worked. We cannot be far wrong in estimating the actual cost at one-fourth of that of the best common road.

Supposing a million to be expended on 1,700 miles of such a railway, then, the saving of cost in conveyance *by it*, as compared with that of conveying the same goods by high-speed railway, would be as follows:

Cost of conveying 60,000 tons 1,700 miles at 3 annas.	192 lacs.	
Do. by cheap railway at 2 pice	11 ,,	
Saving by using the cheap cattle railway.	181 ,,	per annum.

If one-fourth of this, or 45 lacs, were taken as profit to the shareholders, it would give 45 per cent., and the community would have a clear gain of 136 lacs a year besides; against (as shown above) a profit by the high-speed railway of only two per cent. to the shareholders, and of six lacs to the community, on the same capital of one million.

In the same way a million might be expended in greatly improving 10,000 miles of river navigation (if we had so much capable of improvement) at the cost of 1,000 rupees a mile, and this would perhaps reduce the cost of transit, where the rivers are already navigated, by one pie a ton; which, on the Ganges for instance, where the traffic is estimated at two million tons, would amount to 10,000 rupees per mile, or 1,000 per cent. on the outlay. Or, if it

were expended in making navigable a river, not at present available, as in the case of the Godavery, it would create an immense traffic at one or two pice per ton, in a tract of country where there is at present scarcely any traffic, and where the cost of transit is about three annas per ton. Again, it might be laid out in establishing, by means of weirs, perfect steam navigation on the Ganges for an extent of 1,200 miles, at the cost of about 8,000 rupees per mile; reducing the cost of transit from four pice to half a pie a ton, which, on an average of 1¼ rupees a ton, would be a saving of 22,000 rupees a mile, or 350 per cent.

These rough calculations show, undoubtedly, that whether our object be the improvement of the country, or the profitable investment of capital, there can be no shadow of question, that what is most wanted in the present state of this country is a system of works that will materially reduce the cost of transit over a large extent of country, rather than one requiring a large expenditure for a very small extent of communication, however perfect that small extent might be made. I am certain it cannot require five minutes' calculation, to show to any person who is willing to know the real state of the case, that to expend on communications of any kind so large a sum as a lac of rupees per mile, or even a quarter of it, is a complete mistake. If it be said that in these calculations no account is taken of the

passenger traffic, I answer, because they do not materially affect the question. If goods can be carried cheaply at low speeds, travellers can also, and the number who could afford to pay high for a speed above 150 miles a day is so insignificant, as not to stand a moment's comparison with the benefits of *cheap* carriage. And further, by cheap communications, higher rates of travelling can be obtained, for a man will, on the whole, pass quicker over 2,000 miles by means of a low-speed railway, than by means of eighty miles of high-speed railway, and 1,920 of unmade road.

There are certainly not less than 5,000 miles of river navigation that can be made very good, so as to be worked at two pice, or ¼*d.* per ton per mile; and for this a capital of only 50 lacs would be required. If any one thinks that it would be either more profitable to shareholders, or more beneficial to the community, to have fifty miles of high-speed railroad for the same money, he must have a mode of coming to that conclusion different from any I am acquainted with.

But let us now suppose that besides 5,000 miles of river traffic, we require, as I have said, 15,000 of main line of land communications. What will be the results of refusing to have anything but complete railroads on those lines? Even if carried on in all the four presidencies at the rate of fifty miles a year (of which, however, there is little enough prospect

at present), it will take seventy-five years to complete the whole. In all probability, the greater part of these lines would, in fact, continue bare tracks for ever; but if they were made railways, the consequences would be something like this: If the present average tonnage on all these lines be equal to 100 tons a day, or 36,000 tons a year, the cost of traffic may be taken at 7,000 rupees a mile, or 1,050 lacs a year. If the cost of transit were reduced to one-fourth on the railroads, then, as far as the rails extended, it would be 1,750 rupees a mile; and on the rest it would continue at 7,000 rupees. On the average of the seventy-five years, half would be worked at the former and half at the latter rate; and the total outlay would then be—

15,000 miles at one lac . . . lacs	15,000
7,500 miles worked for seventy-five years at 1,750 rupees per mile . .	10,000
7,500 miles worked for seventy-five years at 7,000	40,000
Total lacs . .	65,000
or millions . .	£650

And the outlays by means of the proposed railways completed in fifteen years would be—

15,000 miles at 6,000 rupees . . lacs	900
7,500 miles worked for fifteen years at 1,750 rupees	2,000

7,500 for fifteen years at 7,000 rupees	8,000
15,000 miles for sixty years at 1,750 rs.	15,750
Total lacs . . .	26,650
Saving lacs . . .	38,450
or millions . .	£384

or five millions sterling a year, exclusive of all that would be saved by the new traffic and all the effects of the passenger traffic.

In point of fact, every 100 miles costs the country in transit at least 10 lacs of rupees for every year that the country is kept deprived of the improved communications; and supposing the traffic to be (exclusive of passengers) on the average 100 tons a day (an estimate which is far exceeded on many lines), then on the whole 15,000 miles the loss to the country may be estimated at about 1,500 lacs, or 15 millions sterling, a year.

It is particularly to be observed, that as respects the main point, viz., the time of completing a system of communications, cheap railways have an enormous advantage over common roads. And as regards outlay, the former would cost little more than the latter, while five-sixths of their cost would be for the iron, &c., which would be brought from England, and obtained just as fast as wanted. The preparation of a line of country for the rails with a narrow gauge would cost perhaps one-fifth of the outlay for

a good road, and could therefore be done in about a fifth of the time. No doubt 1,000 rupees a mile would prepare the line for the rails, and hence 100 miles a year might with the greatest ease be laid down in every district, that is, expending only a lac a year on the spot. At the Godavery works, from two to four lacs a year have been spent in the Rajahmundry district. Allowing time for the purchase of materials for bridges, it would only require 3,000 men for ten months to prepare for 100 miles for the rails.

The time saved in laying such a railway as compared with making a road would on all main lines much more than pay for the railway. This shows, in a striking manner, the mistake of going on with common roads on main lines. On the great lines, as for instance those entering Madras, where 30,000 rupees a year are now spent on transit, the whole cost of such a railway would be saved in three months; and if it took five years to make a certain length of common road, instead of one year to lay a railway, the cost of the latter would be saved twenty times over in the time the former would require for its execution.

We have thus shown that there are lines where, independently of the saving in working the railways when laid, it would be as cheap to construct railways at 30,000 rupees per mile in one year, as to make a common road in two years at 5,000 rupees per mile.

Or if one kind of railway could be laid in two years at a cost of 6,000 rupees, it would still be worth while, if necessary, to pay 30,000 rupees per mile for another kind of railway, which, by entailing less labour in preparing the line, would be capable of completion in one year. So important and pressing is the subject of opening lines of cheap communication in India, that we feel safe in saying that there is a loss of two millions sterling to the country for every month that the general opening of India is delayed. If a railway were made entirely composed of wrought-iron beams, supported on cast-iron screw piles of different lengths, so as to render unnecessary all work in the ground beyond screwing in the piles and fixing the beams, it would, in consequence of the great saving of time, be the cheapest communication that could be executed, even though it cost five times as much as a common road or as another kind of railway that took longer to complete. Thus, in continuing to make common roads instead of railways, we not only incur a cost of transit five times as great as that by a cheap railway, but a much greater first cost, taking into account not only the actual expenditure, but also the loss in cost of transit during the time of construction. And in making high-speed railways, there is added thereto the loss in the additional cost of construction. If a railway costing 80,000 rupees a mile be laid over 100 miles in five years, and one composed of beams and

screw piles, costing 20,000 rupees per mile, could be laid over the same extent in a month, on a line costing at present 30,000 rupees a year in transit, then the accounts at the end of the five years would stand thus :—

High-speed Railway.

Cost of 100 miles, at 80,000 rupees .	80	lacs.
Working half of the 100 miles for five years, at 30,000 rupees a mile . .	75	„
Ditto half at four pice per ton, or one-ninth of the present rate . . .	8	„
Total expenditure . .	163	„

Cheap Railway.

Cost of 100 miles at 20,000 . . .	20	lacs.
Cost of working for five years at two pice $\frac{1}{18}$ of the present rate . . .	4	„
	24	„
	163	„
Saving on the cheap railway .	139	„

The difference in the cost of working the two railways, allowing for the interest on the additional capital of 60,000 rupees for the high-speed railway, would be eight pice a ton per mile on a traffic of 160,000 tons a year.

From this it appears that the first would actually cost six times as much in the five years as the second; and the cost of transit would be permanently more than doubled, even though interest be only allowed at four per cent.; and if a larger profit were allowed, the difference would of course be much greater.

No wonder that false conclusions have been universally reached, when the chief element in the question has been left out of the calculations, viz., the present annual loss on the different lines by the means of transit in use.

CONCLUSIONS.

Upon the whole, the main points in this question seem to be the following:—

1. That the great point of all to be kept in view is, not to make the most perfect communication possible on some few hundred miles, in the course of twenty or thirty years, leaving the remaining 100,000 miles untouched; but to adopt a system by which the principal part of the cost of transit will be saved throughout the whole country in the shortest possible time.

2. To accomplish this, we must be content with less perfect communication than high-speed railways at present; because it is impossible that the country can be covered with such, even on a few main lines only, within a hundred years.

3. Cheap railways and good common roads will have the effect of greatly reducing the present cost of transit,—the latter taking off about one-half; and the former probably much more, besides giving us a speed of 200 miles a day for first-class travellers, and from 50 to 100 for goods.

4. That a great extent of river navigation may be

improved, and canals cut, so as to take away nine-tenths of the cost of transit on such lines, at a moderate expense, say from 1,000 to 3,000 rupees a mile.

5. That the proposed rate of $2\frac{3}{4}$*d.*, or nearly two annas per ton per mile, for conveyance on the Bombay Railroad, is really absurd. To give anything like effectual relief to India, we must reduce the cost of transit to one-tenth of that; and even then, without reckoning the difference in the value of money, it will correspond with $\frac{1}{4}$*d.* a ton a mile in England, because for one mile that an article must be carried in England, it must be carried at least five in India.

6. That the rate of $2\frac{3}{4}$*d.* per ton per mile on a railroad that has cost 120,000 rupees a mile, is actually three times the rate at which goods are now conveyed on the grand trunk road in Bengal, and half as much again as on the western road at Madras, which is still in quite an imperfect state.

7. That in general, throughout India, goods can be conveyed on good common roads, on an average, at about eight pice or 1*d.* per ton, exclusive of carriers' profit and interest, even as things are now managed; but that, under European management, they would be certainly carried for less.

8. That with a traffic of 100,000 tons per annum on a common road costing 5,000 rupees a mile, the interest, at 10 per cent., would be one pie, repairs

one pie, and allowing one pie for carriers' profit, the total cost, including the above average of eight pice, would be eleven pice, or say $1\frac{1}{3}d.$; about half of what it is proposed to charge on the Bombay railroad.

9. That on a cheap railroad, worked by cattle, the cost of transit would certainly be less than a quarter of that on a common road, or about $\frac{1}{4}d.$ a ton, including everything.

10. That on a steam canal the cost of transit would not exceed $\frac{1}{2}$ pie, or $\frac{1}{16}d.$ per ton, and the interest and repairs would not exceed $\frac{1}{2}$ pie more, or in all one pie, or $\frac{1}{8}d.$ per ton per mile.

11. That on an improved river, with a constant depth of three feet, the cost of transit would not exceed two pice, or $\frac{1}{4}d.$ per ton per mile, including everything.

12. That the average cost of transit in England may be taken at $1\frac{1}{2}d.$ per ton per mile; equivalent to two pice or $\frac{1}{4}d.$ in India, allowing for the difference in the value of money.

13. That for every mile goods have to travel in England they must be carried at least five in India.

14. That the average value of goods carried in India is much less than that of goods in England.

15. Hence, that even if the cost of transit were reduced to two pice or $\frac{1}{4}d.$ in India, it would, allowing for the difference in the value of money

and in distance, still be equivalent to five times the cost of transit in England; besides that cost being charged upon goods of inferior value, and therefore less able to bear it.

16. That at present, the average cost of transit may be taken at $2\frac{1}{2}$ annas, or $1\frac{3}{4}$*d.* per ton per mile, which, allowing six-fold for difference in value of money, and five-fold for increased distance, is equivalent to 9*s.* 6*d.* a ton a mile in England, or ~~seventy~~ times what it is there; and that paid on less valuable goods here.

17. That a ton of cotton, value 12*l.*, conveyed from Berar to Bombay costs about 9*l.* for transit, including interest, &c.; or, to convey it from the place of production to the place of shipment, adds 75 per cent. to its cost.

18. That a ton of cloth, value suppose 40*l.*, conveyed from Manchester to Liverpool, costs only 5*s.* to convey it from the place of production to that of shipment, which is equivalent to an *ad valorem* tax of $\frac{5}{8}$ per cent., or not more than $\frac{1}{120}$ part of the tax paid by cotton in India; thus showing the comparative state of transit in the two countries, allowing for increased cost per mile, increased time and risk, increased distance, and inferior value of goods.

19. There can be no sort of question as to what is the main cause of the poverty and inertness of India. What would be the state of England if its

cost of transit were equivalent to an *ad valorem* duty on its goods 120 times greater than it now is?

20. That in England perhaps eight millions sterling, or about one-seventh of the amount of taxes, is paid for transit of goods.

21. That in India probably not less than 15 millions, or about three-fifths of the amount of taxes, is paid for the same.

22. That allowing for the difference of the value of money, this is equivalent to 90 millions in England, or eleven times the amount paid there for the same thing.

23. That allowing the actual money cost of transit in India to be $3\frac{3}{4}d.$ per mile, or $2\frac{1}{2}$ times as much as in England, and the distance to be five times as great, there are $12\frac{1}{2}$ tons carried in the former for the same cost as one in the latter. And, consequently, the 15 millions paid in India indicates the transit for a population about six times as great, of not more than one-fifth of the quantity that the eight millions paid in England gives; or, the quantity of goods moved in India is one-thirtieth of that moved in England, allowing for the difference of population; and undoubtedly $\frac{29}{30}$ of the present traffic in England would be stopped if attended with the same expense as in this country.

24. Improved river navigation, canals, and cheap railways could be formed to the extent of 20,000 miles, at an average cost of 3,500 rupees a mile, or

in all seven millions sterling; which would provide for perhaps two-thirds of the present transit (the other third being conveyed by the feeders to the main lines), and save four-fifths of its cost, or eight millions sterling per annum; but at these reduced rates, probably at least five times the quantity of goods now moved would be carried.

25. That as so large a proportion of this would be paid for iron, &c., and as these canals and cheap railways might be begun at once in every district in India, they could be easily completed in five years.

26. That 50,000 miles, with temporary timber bridges, at 3,000 rupees a mile, could be made in the course of ten years, at a cost of about 15 millions, which would save about five millions more in the present goods, and increase the traffic perhaps four-fold in all these lines.

27. If in this way the grand point of cheap transit were secured throughout the country, within a few years the present companies may go on with their snail's-gallop of twenty miles a year, if they please; they will do little harm; but if they are allowed to seal up any important lines of country to the present enormous rates of transit, or anything like it, they will do most serious mischief.

28. With respect to the passenger traffic, the great mass must be carried at about 1 pie, or $\frac{1}{8}$*d.* a mile, or little will be gained.

29. If carried at this rate, or less, the numbers will be immense. At present, over a vast extent of road, there are from 1,000 to 3,000 travellers a day, and probably with an increased speed of from 20 to 100 miles a day, and a charge of only 1 pie per mile, there would be a four-fold increase in the number.

30. The proportion of first-class passengers, or of those who can afford to pay much more for going at 700 miles a day than for going at 200, is utterly insignificant.

31. A speed of 200 miles a day for first-class passengers and valuable goods is abundantly sufficient for the present state of things in this country.

32. A high speed is at present absolutely unattainable. In this respect, the great railroads are a complete delusion. In ten years, perhaps, 500 miles may be opened, leaving the other 19,500 of main lines to be traversed at three miles an hour.

33. If we will be content with a moderate speed of 200 miles a day, we may have it all over India in five years. If we will not have this, we must go on at three miles an hour over the greater part of the country, for centuries to come.

34. The present plan for opening India by high-speed railroad is like preparing our loaf by taking the wheat, grinding, kneading, baking and eating it, grain by grain, and dying of famine all the time, with our food before us. India will be starved to

death while the railroads are constructing. Famine may depopulate the country before they are carried to any considerable extent.

35. The same money and same length of time required to make one mile of high-speed railway, will be sufficient to make 100 miles of good river navigation, twenty-four of first-class steam canal, twelve of very good low-speed railroad, twenty of an inferior kind, and forty of perfect common road with timber bridges, or twenty-four with masonry works.

36. We have to deal with a present direct burthen on the country, of probably, at least 15 millions a year, in actual payments for transit, equal to three-fifths of the whole taxes, besides a loss of at least an equal amount on the goods not carried; in all, 30 millions, or much more than the whole revenue.

37. By a judicious expenditure on communications, such a portion of this may be saved as will relieve the country to the extent of the whole of the present taxes, while its effects in stimulating the country will be far greater than in the money saved.

38. The present railway between Bombay and Madras, if carried on at both ends, as it has been at Bombay, at the rate of ten miles a year, will be completed in forty years, and cost, perhaps, six millions (80,000 rupees a mile) for a single way; and in the

meantime there will have been spent on transit, by the present tracks, about 16 millions sterling (10,000 rupees a year per mile, on 800 miles for half the time), sufficient to lay an excellent low-speed railroad sixteen times over.

39. In a very rich country, already provided with a complete system of *cheap* transit, *high speed* of transit is the grand object to be sought. But in a very poor country, paralyzed by utter want of means of transit at a moderate cost, speed, in forming a general system of cheap transit, is the grand desideratum to which everything else should give way.

40. A carriage and pair is the ruin of a young apothecary with a patient a day, while it is a very economical expedient to a physician with more patients than he can reach on foot.

41. A more effectual expedient could not have been fixed upon to retain India in its present beggarly state, than to keep its rulers and all others interested in it amused with laying down annually thirty or forty miles of fine railroad, while the whole country is starving for want of anything in the shape of cheap communication of any kind.

42. One of the greatest evils of India is the cumbrousness of its ruling apparatus; to meet this difficulty, the railways carried on by means of

1st. The Board of Control,

2nd. The Court of Directors,

3rd. The Government of India,
4th. The Local Government,
5th. The Shareholders,
6th. The Managing Committee at home,
7th. The Consulting Engineer at home,
8th. The Manager in India,
9th. The Government Inspecting Engineer,
10th. The Local Engineer,

and their progress corresponds with this.

43. Compare this with the arrangements for the electric telegraph. A single officer, as active in his movements as his own electric sparks, is sent home, and in direct communication with the Court makes all his arrangements, and no doubt his progress will correspond. Which of these two plans is most suited to the circumstances of India, when demanding 100,000 miles, whether of communications or of telegraph?

44. The interests of shareholders coincide with those of the country. Capital, employed on cheap communication, will return ten times that laid out on expensive ones. A lac of rupees, spent on a mile of high-speed railway, would save 12,000 rupees a year out of 16,000 rupees (the present cost of transit of 100,000 tons a year). The same sum spent on ten miles of cheap railway would save 100,000 rupees a year: and if half the saving were taken on tolls, the respective profits would still be six and 50 per cent.

45. The profits in the investment would be as great in common roads, and much greater in canals.

46. The fields for employment of capital, giving enormous returns, is unlimited in India. It is represented by 15 millions clear saving that may be effected on the cost of the present transit, representing a capital of 150 millions at 10 per cent. The whole expenditure on railroads in England was about 200 millions, yielding only three per cent., or six millions a year; and England has now before it a clear field for the employment of capital that will yield at least two and a half times as much as the railway capital in England; and if they will be content with only three or four times as much per cent. in profit as the English railways yield, they will still make India a present of many millions a year.

47. The present railways may demand 5,000 tons of rails a year, whilst the plan proposed of opening the country at once may take 50,000 or 100,000 tons a year.

48. Who can estimate the effects in England of throwing open all India by cheap transit, and relieving it from an expense of 15 millions a year, making it at once a comparatively wealthy country, and universally a market for English manufactures?

49. Who is not interested in this undertaking? The directors, persons of every class who care for the temporal and spiritual welfare of India, the aboli-

tionists whose object is to take off the premium on slave labour by bringing in cheap Indian cotton, the societies for spreading the Gospel through India, the Manchester, Sheffield, Birmingham, Yorkshire manufacturers,—is not in fact almost everybody in England personally and deeply interested in this?

50. Who is there to prevent this being entered upon at once? the money, the iron, the country, the people, everything is ready. The Court have but to issue the orders, and the communications may be commenced at 100 points, and opened almost as soon as O'Shaughnessy can lay his telegraph.

51. Everything depends upon our giving up this idol *speed.* Besides some thousands of miles of good water communication, which can be had at a small outlay if this is given up, railway can be laid with steep gradients, sharp curves, light rails, a narrow gauge, timber viaducts, &c., so that 3,000 or 4,000 miles a year can easily be completed.

52. Nobody is more interested in this than the shareholders in the high-speed railroad themselves; for by means of these cheap railways the great mass of the traffic may at once be brought upon such few miles as they may finish, instead of waiting for forty or fifty years before one main line is completed. Wherever they work, they ought to begin by laying a cheap railway over the whole length of the line; which would immediately give them enormous interest for their money.

53. That in respect of the main object in every country, whether rich or poor, viz., cheapness of transit, nothing can compare with internal navigation; and that, without this, a continental country must, owing to the great distances to be traversed in it, be almost entirely cut off from foreign commerce.

54. That even if there were railroads all over India, it would still be worth while, nay, necessary, to open lines of navigation, because, after all that can possibly be done with railroads, goods cannot be carried nearly so cheaply by rails as by water.

55. That generally the cost of transit by different channels in India may be thus estimated:—

By the present unmade roads. . . .	3 annas,	$4\frac{1}{2}d.$
By perfect common roads	8 pice,	$1d.$
By first-class railroads (high speed) .	4 pice,	$\frac{1}{2}d.$
By cheap railroads (low speed). .	2 pice,	$\frac{1}{4}d.$
By unimproved rivers	4 pice,	$\frac{1}{2}d.$
By improved rivers	2 pice,	$\frac{1}{4}d.$
By improved rivers, down stream . .	1 pie,	$\frac{1}{8}d.$
By steam canals.	$\frac{1}{2}$ pie,	$\frac{1}{16}d.$

56. That the line of communication for goods between Europe and the upper valley of the Mississippi depends entirely upon the inland water communications; it is not in the least affected by the railway. The struggle is exclusively between the Erie and St. Lawrence canals, and that in a country

where they are closed for five or six months in the year by frost.

57. That Agra being only 500 feet above the sea (1,200 miles up the river), forty annicuts (weirs), which might cost on an average three lacs (in all 120 lacs), would give, at the rate of 7,500 rupees (750*l.*) a mile, a perfect steam navigation, with still water for eight months in the year; much superior to the Mississippi, as being without its disadvantages.

58. In Berar cotton is grown at $1\frac{1}{4}$*d.* a lb., while the people are fed on rice, which costs four times the sum for which it could be brought from Rajahmundry by the Godavery; and it is the same with the salt they use.

59. That in communications, we have this paradox, that a diminution of cost of transit, however small, may produce an effect, however great, in creating a demand. Upon a reduction of cost of transit by as little as five rupees a ton on 1,000 miles, may depend whether it is profitable or not to convey some great staple article of commerce to another mart. For instance, upon this may turn the sale, and consequently, the cultivation of an article of commerce, to the amount of a million tons a year, thereby bringing in an income to a country of suppose 10 millions sterling a year.

60. In so cheap and populous a country as India, the whole foreign trade (to say nothing of that

which is internal) hangs upon this, the cost of internal transit.

61. Whatever is ultimately done, there is at present only one object to be kept in view, viz., *speed* in *making* communications.

62. Whatever is ultimately done, there is one thing that *must* be rejected, as destructive of all we aim at, even itself, viz., *speed* in *working* the communications. If we give up this, we can do anything, throw open all India to every wholesome influence at once; but if we persist in aiming at this, we can do nothing, however busy we may appear to be.

WATER: ITS VALUE AND COST.

The savages of Australia trod upon gold for hundreds of years, while they were often in want of food, and always without a rag of clothing. And very similar hitherto has been the state of things in India. With an unlimited supply of water within reach which would more than provide for every possible want, the people of India have been generally barely supplied with the necessaries of life, and often so entirely without them as to perish by hundreds of thousands; and their European rulers, with this treasure within their reach of far greater value, in proportion to the cost of obtaining it, than the richest gold-mine in the world, have been unable to make their income equal their expenditure.

It seems as if in India men had universally jumped at the conclusion, that because water was immensely valuable it must therefore be immensely costly, without stopping to calculate what its cost really was. A person in India, in the midst of the hot season, necessarily forms in his mind an idea of the immense value of water; but it does not readily occur to him that what is so valuable may be

at the same time the cheapest thing in the world; just as it was at Port Phillip, where the last thing that men were inclined to suppose was that so valuable a thing as gold was under their feet in tons.

Our question then is, What is the *value* and the *cost* of water in India? We will not stop here to inquire what its value is for drinking; that of course is inestimable, the same also so far as it is required to prevent famine; we must content ourselves here with a calculation of its value for those purposes which come within reach of a money valuation. These are, 1st, Irrigation; 2nd, Navigation.

In irrigation water may be used in three ways.

1st. For the complete irrigation of a crop which requires to be constantly and abundantly supplied beyond what the ordinary monsoons afford.

2nd. To enable us to grow, at those seasons when no rain at all can be expected, things that require only a trifling quantity of water.

3rd. As in the case of sugar, to enable us to grow what requires so long a time to nurture that the monsoon is not of sufficient duration.

The first kind of irrigation is in this part of the country chiefly required for rice, of which there are innumerable kinds, requiring from four to six months to nurture; but as it is usually in the seed-beds for a month, and requires no water for the last month or six weeks, water is only necessary for from two to four months, excepting the little re-

quired for the seed-beds, which are only $\frac{1}{30}$ part of the extent of the transplanted crops. When rice is grown in the height of the hot season, the evaporation, in the Madras Presidency, generally being nearly half an inch a day, it follows that about 70 cubic yards a day would be evaporated from an acre of rice-land if fully exposed to the action of the wind. From experience this does, in fact, seem to be about the extreme quantity required for rice; but the average required during the whole crop appears to be considerably under this even in the hot season. Supposing a six months' crop, it would for four months, at this rate of 70 cubic yards a day, require 8,400 cubic yards. It never certainly consumes this quantity; but, on the other hand, it is always very important that the water should occasionally be changed; and allowing for this and for great waste, we commonly reckon that 7,500 cubic yards are required for an acre as the extreme quantity. The four months' crop of course requires only about 4,000 cubic yards, but it is proportionably less valuable. If grown in the monsoon, a large proportion is supplied by the rain. For instance, 30 inches of rain may fall, which is equal to 4,000 cubic yards in an acre; but much of this is lost, because it falls in too large quantities at a time, and therefore runs off to waste. But supposing that one-half of this quantity, or 2,000 cubic yards, be available, it leaves 5,500 cubic yards to

be supplied artificially for a six months' crop; or we may allow 5,000 cubic yards on an average for the four and six months' crops during the monsoon, and 7,000 for those grown in the hot season.

The value of the produce of an acre of rice-land must of course vary very much, according to the nature of the soil and the market price of rice; but in the Madras Presidency we may take it on an average at 15 rupees, the weight of produce there being about 1,200 lbs.

The produce of unirrigated land is of course much more variable on account of the precarious nature of the rains, a large portion of the crop being constantly lost from excessive or from deficient moisture. We may take the average value of dry crops grown in the rainy season at six rupees per acre, leaving nine rupees as the difference due to water. The additional expenses of rice cultivation above that of dry cultivation are not easily averaged, because they consist partly of the interest of money invested in the preparation of the land, and partly in the transplanting, &c. We may, however, safely allow an increase of six rupees per acre as due solely to the water. This would give 5,000 cubic yards for six rupees, or 800 cubic yards for one rupee. In the hot season more water is consumed, but the crop is proportionally more valuable. If we allow that water for rice is worth one rupee per 1,000 cubic yards

when so used, we shall certainly not overvalue it in this part of India.

The second way in which water may be used is for the cultivation of what we call dry grains in the dry season. For this purpose very little water is required; sometimes little more than the moistening of the soil at first, to enable the ryots to plough and to make the seed germinate. One of the principal dry grains, cholum, cannot bear heavy rains at all after it is one or two feet high; if the rain continues two or three days, the whole crop rots as it stands, and this frequently happens. Often it does not get a drop of rain after it is a foot high, and then there is an abundant harvest. One of the great uses of having water at command is to enable the ryot thus to grow his grains at whatever season he pleases. If the cholum crop could be sown after the heavy rains are entirely over, it would never be lost, and the very little water required for it would easily be secured. Again, in the height of the hot season, when the agricultural population is scarcely at all employed to any good purpose, a very small quantity of water is sufficient to enable them to grow a crop of some dry grain. In this way tens of thousands of acres in the delta of the Godavery, where nobody until lately thought of attempting to grow anything in the hot season, are now, in consequence of a supply of water being at command, covered with

crops of oil-seeds and other things. For with these crops a first watering of about four inches, or 500 cubic yards per acre, with perhaps as much more during the growth of the crop, secures the harvest. Thus the difference between the cost of cultivation and the selling price of the produce is the value of this 1,000 cubic yards of water. This of course varies greatly; but reckoning it at three rupees, that makes the water worth one rupee per 330 cubic yards in the hot weather.

The third kind of irrigation applies chiefly to the cultivation of sugar, chillies, &c., which require water for a greater length of time than the monsoon lasts. Sugar is of course a thing of first importance. In the Presidency of Madras it is a ten or eleven months' crop, and requires water till within a month of its being cut. Its consumption of water is very great. In the height of the hot weather, when it is quite young, and only two or three feet high, it takes 70 cubic yards a day per acre; and probably during the monsoon, when it is ten or twelve feet high, it consumes much more. In the cold season, when it is approaching to ripeness, it will take up three or four inches of water in a few hours. We may reckon that it requires on an average, besides what it gets from the rains, 50 cubic yards per day for 300 days, or 15,000 cubic yards in all. The value of the crop in highly cultivated rich land may be taken at 120 rupees an acre, and the cost of cultivation (including

land-tax) at 70 rupees, leaving 50 rupees as the value of the water, or one rupee per 300 cubic yards. In the delta of the Godavery, water used to be raised from the river or from wells for this purpose at a cost of about 500 cubic yards per rupee, or 30 rupees per acre, leaving 20 rupees as the profit. The price at which it is now actually purchased extensively for irrigation is of course an unanswerable proof that it is worth more than that. Millions of cubic yards of water were purchased annually in the Madras Presidency at prices varying from 1,000 to 300 cubic yards per rupee, the cost of raising it from wells and rivers.

It not necessary here to attempt to estimate the value of water for the innumerable other products for which it is used, such as plantains, cocoa nuts, betel, &c. I think we are quite safe in reckoning that in the Madras Presidency, generally, it is worth, in ordinary seasons, one rupee for 500 cubic yards, for irrigation. Of its value in seasons when the local rains fail, who can form any judgment? If 1,000 cubic yards would secure the crop in an acre of cholum, thus providing 1,000 lbs. of food, or more than sufficient to feed two individuals for twelve months, and in time of scarcity to preserve the lives of perhaps a dozen, till rain falls; then every 100 cubic yards may be the means of saving the life of one person.

Thus, in different ways, we attain to a certainty

that water is worth at least a rupee for 500 cubic yards in ordinary seasons, when applied to the land. Every square mile of India receives from the rains, on an average, probably at least two-thirds of a yard more water than is consumed in evaporation, so that the rains supply two million cubic yards to be stored for use, which, at the above rate, would be worth 4,000 rupees per annum.

We may next estimate the value of water for navigation. There are three ways in which it may be so used, viz., 1st. In keeping the rivers navigable.

2nd. In supplying canals which are kept on a dead level, so that the only consumption of the water is in evaporation and leakage.

3rd. For flowing canals.

As the use of water for the artificial supply of rivers for navigation is not in practice in England or America, and so far as I know has never been suggested in engineering works in those countries, till of late by Mr. Ellet, in his admirable papers on the navigation of the Mississippi, it will be necessary to go as fully into it here as our present data will allow. I should mention that I remember many years ago hearing, that in Russia some rivers were made navigable upon this principle, though only in an imperfect manner. Water, stored in lakes or reservoirs, is discharged at certain fixed intervals, so as to give a flush for a few days in those streams, which is

taken advantage of by the boats which have previously been collecting in the line of navigation. This is precisely the plan I would propose, excepting that the supply should be made constant. That this plan should never have been adopted in England, is perhaps owing to the considerable fall per mile which the rivers there generally have; and also to the value of land, and consequent expense of reservoirs. It is, however, more probably owing to the idea never having occurred to engineers there. Mr. Ellet seems to have been the first to suggest the plan in America, but whether it has yet been acted upon, I do not know. His report is one of the ablest papers ever written by an engineer, and will one day assuredly be duly appreciated. In a lake country, like Wales and others, there are peculiar facilities for such an undertaking, because, by closing the mouths of the lakes, large bodies of water may be retained at a comparatively small cost. In this way it was therefore suggested by an Indian engineer, some years ago, to improve the Severn navigation. And in Van Diemen's Land, many years ago, one of the innumerable lakes there had a slight dam placed at its mouth, to secure, during the summer, a better supply of water for the mill situated in the river that flowed from the lake. A very complete work of this sort was also executed in that island at the suggestion of an Indian engineer, at the head of another river. A large lagoon, situated high up in the hills,

was dammed up by a high and strong earthen bund, furnished with a sluice, so as to form a tank and secure a very considerable body of water. In that part of the island the fall of rain is extraordinarily small, and the river, issuing from this lagoon, was always dry for five months in the year, and sometimes had scarcely any water in it, even in the winter. But since the year 1839, when the bund was built, till it was last heard of, in 1848, the river had never been without a large stream in it; and in one year, when there was almost a total failure of rain, the supply of water from the tank was sufficient to keep up the stream through a whole winter, with scarcely any other accession of water.

This mode of improving the navigation of Indian rivers has been singularly lost sight of; and what makes it still more remarkable is, that the abstraction of water from navigated rivers, for purposes of irrigation, to the endangering of the navigation, has, to a certain extent, roused attention to the subject, so much so that a few years ago an experiment was made in the Jumna, to try what effect the abstraction of the water had upon that river. By closing the canals that lead from it, for four days in the dry season, the water was raised 1¼ feet, and probably it would have risen more had the canals been kept closed for a longer time, for from the diagrams given in the report published, it appears that the river continued to rise up to the last moment before it

began to fall again. Had the canals been kept closed sufficiently long, it would have remained stationary for a time, when at its highest. The quantity turned into it was about half a million cubic yards per hour, showing that 12 million cubic yards a day, or 360 millions a month, would in the low state of the river have afforded an additional depth of 1¼ feet; and supposing the river to have had two feet in depth in its previous state, this additional depth would make the difference between a stream scarcely navigable, and one quite available even for steamers. This is a highly important experiment, as giving the positive effect of a known quantity of water in an ordinary Indian river of a certain size. It is very unfortunate that no observations were made as to the effect of this water in the Ganges below the confluence of the Jumna, but no doubt the effect would not have been less than three-fourths of a foot on the depth of the main river; for although the lower Ganges is much wider, its fall per mile is less than that of the Jumna. The report of this experiment is published in the papers of the Agra Presidency. Probably one reason why even this did not awaken attention to this most important subject was, that public attention in England has of late years been absorbed by railroads as means of communication, and that the impression upon people's minds generally, and even upon those of engineers, has been, that we have done for ever with internal water com-

munication, and that railroads have entirely taken their place. This idea is entirely without foundation, for railroads probably never can supply the place of water communication, because the cost of working them far exceeds that of navigable rivers or canals. Railways cannot contend with the latter in cheapness, even where they have the immense advantage over them of steam-power. Steam canals, such as are now in use in Canada and the United States, are worked so cheaply as to leave scarcely any possibility of railroads ever competing with them in this respect, which is the main point as regards the great mass of traffic everywhere.

It is from a misapprehension on this point, I conclude, that even when the subject was so nearly brought forward, in consequence of the canals in the north-west being led off from navigated rivers, it still escaped investigation. A few minutes' calculation would have shown that the subject was well worthy of the closest scrutiny. The Ganges is the grand artery of Bengal and the North-West Provinces, and upon the cheap transit by means of it, hangs the whole present state of things there. Not a tenth of the goods carried down it could bear the cost of 500 miles of land carriage, nor even the doubling of the present cost (four pice or ½*d.* a ton a mile). Without this cheap line, the trade of Calcutta and the revenue of Bengal and the North-

West Provinces would fall to a small fraction of what they now are.

We may now proceed to form an estimate of the value of water for the navigation of rivers, from such data as we have. We may begin with the Jumna, as we have an approach to an experiment in the effect of a certain quantity of water on it. It is stated in the railway pamphlets, that the traffic above Allahabad is one million tons a year. If we take this as equally divided between the Jumna and the Ganges, or 500,000 tons to each, and the present cost of transit at four pice per ton per mile, and if we take the mean distance of transit at 300 miles, we have paid for transit on the Jumna a total annual sum of 30 lacs, or 300,000*l.* sterling. But additional water thrown into the Jumna also raises the Ganges, and the cost of traffic on that river below the confluence, calculating about 2,000,000 tons for 7,550 miles, at four pice per ton per mile, amounts to about 220 lacs, or nearly 2¼ millions sterling. If this traffic were equally distributed over the whole 1,200 miles of navigation from Delhi to Calcutta, it would be equal to 18,000 rupees a mile, and 1¼ million tons carried the whole distance.

If we suppose half of this carried during the six driest months, when the river is injuriously low, we have 600,000 tons, and an expenditure of 9,000 rupees a mile, or a total on the whole length of

navigation of one million sterling, affected by the state of the river. Any increase or diminution of depth which affected the cost of transit to the extent of one pie, or $\frac{1}{8}d.$, that is, one-fourth of its present cost, would, therefore, increase or diminish the money expended on transit to the extent of nearly 300,000*l.* or 30 lacs a year: so important a thing is this magnificent line of navigation. But this difference of rate of transit would produce a much greater effect than is shown by this sum of money, for it would materially increase or diminish the amount of traffic. A great quantity of goods which can be carried at four pice per ton, or 20 rupees for the whole average distance of 950 mlles, would not bear a charge of five pice a mile, or 25 rupees for the whole distance. And, on the other hand, many things that cannot be carried at 20 rupees a ton, would afford a merchant an ample profit, if carried at 15 rupees. So immense is the effect of cost of transit, that probably one rupee a ton on a distance of 1,000 miles is sufficient to turn the scale, and make the difference of whether an article is saleable at a distant market or not.

The question then remains, What increase of depth of water may effect a diminution of one-fourth, or one pie per ton in the cost of transit? Supposing the Jumna to be, on the average of these six months, 2½ feet deep at the shallows, and that the above quantity of water raised it in an average

of the same time one foot, thus providing a depth of 3½ feet, this may fairly be supposed to allow of the boats carrying double what they would when drawing only 2½ feet. A double load on the same boat would of course nearly, if not quite, halve the cost per ton, of working it; for, besides the additional load, there would be the advantage of much less delay and risk from running aground. In the Ganges the difference of depth would be less, perhaps on an average about half a foot. We should, however, be well within the mark, if we allowed that this addition of water would reduce the cost of transit by one-fourth, or make the difference of one pie per ton per mile, producing a total saving of 40 lacs a year, besides all the profit in the new traffic created by the reduction of rates. The quantity of water required, as above, to produce this effect is 12 million yards per day for 180 days, or in all, 2,160 millions of cubic yards. This divided between 40 lacs of rupees gives 540 yards per rupee.

This is certainly a very low estimate, and in the case of the Ganges and its feeders, we may, therefore, confidently reckon water worth one rupee per 500 cubic yards.

Let us try another river: the Godavery is at present not navigated at all by boats, no doubt owing to the uncontrolled powers of the petty Zemindars on its banks, who assume the right of demanding dues on everything that passes. The

taxations endured by the owners of timber and bamboos rafted down the river are quite enough to prevent any traffic by boats. It has, however, at a previous period been navigated for six months in the year, viz., from the middle of June to December, and probably during this time there is never less than three feet at the shallows, as far as Wooni on the Wurdah, 450 miles from the sea. In December there is about 600,000 cubic yards, on an average, per hour, and at the lowest about 100,000. To keep up three feet throughout the dry season would probably require an average addition of 400,000 cubic yards an hour, or for the six months 1,800 millions. Our data at present are far from sufficient to enable us to calculate with certainty, but we shall probably be quite safe in allowing 3,000 millions, which would give 700,000 cubic yards per hour.

The traffic from the upper part of the basin of the Godavery, towards Bombay and the Ganges, appears, from the statements given by the railway engineers, to be at least 100,000 tons a year of things merely seeking the cheapest access to a port, and which would, consequently, be all carried by the Godavery, if the navigation were open.

In such a case as this, however, it is evident that the present amount of traffic cannot, in the remotest degree, indicate the amount of traffic there would be by the river if easily navigated. At present goods are carried from the upper part of the Godavery

basin to Bombay, over 300 miles of land, at three annas per ton per mile, or 56 rupees per ton for the whole distance; or conveyed 400 miles by land to the Ganges, for about 70 rupees per ton, and thence by the latter river 600 miles to Calcutta, at four pice per ton per mile, or 12 rupees per ton for the voyage; making a total from Berar to Calcutta of about 80 rupees a ton. If brought by the Godavery, it would cost only about two pice per ton per mile, were that navigation put in order; or the total charge would be nearly five rupees a ton from Berar to the port of Coringa. If to this we add an average of thirty miles of land carriage (which would take in a very great range of country), it would add only 5¼ rupees, so that the total charge would be not more than 10¼ rupees per ton, or about one-seventh of the average cost of conveying it to Bombay or Calcutta. Were the river opened, no doubt the land communications leading to it would soon be improved, and the total cost reduced much below this; but I take the cost by land as it is now. If instead of 100,000 tons we suppose 500,000 to be conveyed at this reduced rate of one-seventh, the total saving, calculating at only 50 rupees a ton, would be 250 lacs a year; which, divided by 450 miles of navigation, would be 55,000 rupees per mile. Supposing that half of this were carried during that half of the year when the river is now navigable, it would leave the other half, or 27,500 rupees

a mile per annum, as the direct saving effected by throwing water into the river. But besides this, a great portion of the other half should be also credited to the improvement, because the keeping the river navigable throughout the year would be the principal thing to lead to its navigation generally. We may, therefore, safely allow 35,000 rupees per mile as the value of the water, or 150 lacs a year for the whole distance of 450 miles.

If, as above stated, we require 3,000 millions of cubic yards of water, this divided among the 150 lacs saved, gives 200 cubic yards per rupee, against 500 cubic yards per rupee, calculated as the value of additional water in the Ganges, because the whole traffic of the Godavery basin is at present carried by land, and the saving by the introduction of water carriage is of course much greater even on a less amount of traffic.

We may next try to calculate the value of water used for navigation in an ordinary canal. We have some data for the cost of a canal, in the case of the Ganges project, where 850 miles of canal, varying from sixty to ten yards wide, and from ten to six feet deep, is expected to cost 160 lacs, or about 20,000 rupees a mile. This canal has very few locks, but it has some very heavy works near its head. From this, as well as from general experience in hydraulic works, I think we may safely allow, that a vast extent of complete steam canals, twenty-five

yards broad, and eight deep, with locks to admit screw steamers of 300 tons, might be executed in India at 20,000 rupees a mile. There are, of course, tracts of country where they would cost much more than this, but we need only at present occupy ourselves with those where such works could be executed without excessive expense. We may take for example, the line connecting the two coasts of the Peninsula, from Negapatam, in Tanjore, to Ponany on the west coast, a distance of 350 miles. This would be one of the most important lines that could be found.

1st. As passing through a vast population, and having so near its line towns of 20,000, 30,000, and perhaps 40,000 (Coimbatore) inhabitants. Within fifty miles on either side there are probably 4 millions of inhabitants.

2nd. As connecting two coasts, each of which are closed to trade for about three months of the year, but at different seasons, so that by means of very cheap water transit between the two, the produce of one coast could be shipped at the other, at that season when the latter is open and the former closed. On this line there is not a single serious engineering obstacle; but there is an ascent of about 1,200 feet to the water shed, which would require about 150 locks on each side, or nearly one per mile; and near the water shed they might be placed by two or three together. They would cost about 15,000 rupees for

every ten feet of lift, or about 10,000 rupees a mile. The excavation, &c., on this easy line could be done for about 10,000 rupees a mile, making in all 20,000 rupees a mile for the whole length of canal. If the locks were 150 feet long, by 15 broad, the water consumed by them, allowing a traffic of 300,000 tons (1,500 boats of 200 tons each), at 1,000 cubic yards per lock-fall, would be 1½ million cubic yards, or 4,000 cubic yards per mile of canal. And the consumption of water by evaporation, allowing a breadth of twenty-five yards, at two yards per annum, or on an average of one-fifth of an inch a day throughout the year, would be $25 \times 1,800 \times 2 = 90,000$ cubic yards per mile, or including leakage, say 100,000 cubic yards per mile. The loss by leakage would be very small, for in the Peninsula, if good slopes are allowed, tanks and channels become soon puddled by the sediment from the water. If the traffic is 300,000 tons a year, which it would probably be on this line (or at least equal to that, including the immense passenger traffic there would be), taking the present cost of carriage at 2½ rupees, and the charge in the canal at 1 pie, the saving by the canal would be 46,000 rupees a year, for a consumption of water of 100,000 cubic yards, or two cubic yards per rupee. But in this case there would be a capital required for the canal of 1 rupee for every five cubic yards of water, in addition to the cost of storing it.

Though these calculations are far from showing accurately the value of water for different purposes, yet they undoubtedly give it sufficiently nearly for our present purpose, viz., to show that the value is extraordinarily high, compared with its cost, which we will next proceed to estimate.

We obtain the use of water for irrigation, &c., by two means: 1st, by diverting it from rivers, by means of weirs and channels; and 2nd, by damming up small streams with earthen bunds, and thus forming tanks in which it is stored up during the local rains.

We have a good instance of the first mode in the use of the Godavery works. Up to the present time about 18 lacs have been spent on these works (besides annual repairs), and probably 25 lacs will complete the whole undertaking, including making all but the very small channels navigable, so that there will be about 1,200,000 acres irrigated and drained, and almost 1,000 miles of navigation. The total cost of the water so distributed may then be thus estimated.

	Rupees.
4 per cent. on 25 lacs.	1,00,000
Repairs and management. . . .	1,20,000
Total annual expense	2,20,000

The total quantity of water distributed for this will be five months at 1,200,000 cubic yards per hour.	4,300 millions.
Seven months at an average of 400,000 cubic yards per hour =	2,100
Total million cubic yards per ann.	6,400

This, divided between the above 2,20,000 rupees, gives 30,000 cubic yards per rupee. But this includes the cost of both irrigation and navigation. If the benefit of the latter be only one-fourth of that of the former, it will leave the cost of the water for irrigation about 1 rupee per 40,000 cubic yards, against from 300 to 1,000 cubic yards per rupee for its value.

There cannot be much room for error in this calculation, because the works are now so far advanced as to enable us to form a very fair judgment of their total cost.

Who can be surprised at hydraulic works being profitable to both government and people, when the *cost* of the water is only $\frac{1}{80}$ part of its *value*? It must be remembered that this water is applied to the richest alluvial land, and that in the freshes it comes down loaded with such a rich sediment, as perfectly to renovate the land annually. In Tanjore, the land has borne either one or two crops of rice annually,

for centuries, without any manure, and a great deal of it is of very inferior quality.

This is a case of river irrigation on a very large scale, and gives perhaps the lowest rate at which water could be obtained for irrigation in this way. The works are however heavy, the weir having a clear water-way over it of 2¼ miles broad, besides six large sets of sluices, three locks, wingwalls, &c., in a river with a bed of loose sand, and twenty-nine feet deep in the freshes. The three main channels will have a breadth together at their heads of about 130 yards. There will be probably 1,500 miles of channel, and 5,000 irrigating sluices, fifty locks, besides small weirs, aqueducts, tunnels, bridges, groynes to restrain the river, &c.

The cost of obtaining water by the second means, viz., by constructing tanks to collect it during the local rains, may be shown thus.

It is evident that if the fall of the country is eight feet a mile, which is much above the average fall in India, a bund ten yards high would retain water of a breadth at the surface of nearly four miles, or 7,000 yards; and as its main depth would be half that of the bund, the quantity of water stored per running yard of bund, would be $7{,}000 \times 10 \times \frac{1}{2}$ or 35,000 cubic yards. This is the simplest form of the question. In practice, sites for tanks would always be chosen where the form of the ground assisted the operation; that is, where a natural rise

or a hill would form part of the bund. Allowing that with such assistance, the capacity of the tank, in comparison of the length of the bund, would be doubled (which is probable), this would give 70,000 cubic yards for every lineal yard of bund. To retain water ten yards deep would require a bund about thirteen yards high, five yards broad at the top, and sixty at bottom, containing about 400 cubic yards of earth for every running yard, which in the Peninsula would cost about one anna, or $1\frac{1}{4}d.$ a cubic yard, or 25 rupees in all. This must be lined with loose stone, at a cost of about five rupees (ten cubic yards at half a rupee), which would make 30 rupees a yard lineal of bund. To this must be added something for a waste weir and sluices, suppose 10 rupees.

The annual cost would then be,

	Rs.	a.
4 per cent. on 40 rupees. . . .	1	10
Repairs, &c., at 2 per cent. . .	0	13
Annual cost per yard of bund	2	8

or $2\frac{1}{2}$ rupees for 70,000 cubic yards of water, equal to 28,000 cubic yards per rupee.

If the whole of the water is to be used for one crop of rice, or in a time a little longer than the rain lasts, we may safely add 50 per cent. to its contents for the water that will be added after it is first filled, to replace the water drawn from it

for irrigation. This will therefore make the cost one rupee for 42,000 cubic yards.

But if, as in the case of large tanks from which irrigation is carried on all the year, an allowance is to be made for evaporation, we may reckon that the gain by refilling during the monsoon about balances the quantity withdrawn.

Every square mile of country will give two millions of cubic yards of water, and consequently for a tank containing 100 millions (the capacity of the Veranum tank in South Arcot), the drainage of 50 square miles, or an area of seven miles square, would be required.

Let us next see what the cost of water is in the North-West Provinces.

According to Captain Baird Smith's estimate, the cost of water for irrigation there is as follows:—

The Ganges canal is estimated to cost 160 lacs, and to supply 900,000 cubic yards of water an hour, or 8,000 millions per annum, which would make the expenditure of capital one rupee for 500 cubic yards per annum; and if we allow 4½ lacs a year for current expenses (7*d.* an acre), the actual cost of water at the present rate of interest will be—

Four per cent on 160 lacs .	6,40,000	rupees.
Annual expenses	4,50,000	,,
	10,90,000	,,

which, divided among 8,000 million cubic yards, gives 7,300 cubic yards per rupee.

The cost of the western Jumna canals has been (from the same authority) 12 lacs of rupees for a supply of 300,000 cubic yards per hour, and the current expenses are 90,000 rupees per annum, making the cost of water

Four per cent. on 12 lacs . .	48,000	rupees.
Annual expenses	90,000	„
	1,38,000	„

which, divided between 2,500 million cubic yards, gives 18,000 cubic yards per rupee.

The cost in the north-west is therefore from 7,300 to 18,000 cubic yards per rupee, against about 27,000 in Rajahmundry. The cause of this excess of cost in the north-west is partly from the difference in the nature of the works necessary there to lead the water to the surface of the land, and partly from the works being executed upon a more expensive plan.

Of the cost of water there if obtained by means of large tanks we have no account, as such works have not yet been executed by our Government; and I have no calculation of the cost and capacity of the small tanks constructed in that part of the country in former years. I think, however, that in a country with so moderate a fall as that has, water

could be stored in tanks much cheaper than it could be drawn from the river. It would, however, have this most important disadvantage, that the tanks would not suffice to prevent a famine,* unless a supply was always left in them sufficient for the second year, in case of a failure of the local rains. It would therefore be necessary to make them of a capacity to contain about three times the quantity required to irrigate the lands dependent on them for one year, so as to provide for two years' consumption, and the great evaporation there would be in a year of drought. If, however, they could retain water at a cost of 22,000 cubic yards per rupee, they would still be as cheap as the Ganges Canal Irrigation Works, and would have the immense advantage over the latter of leaving the river navigation uninjured, except in case of a famine, which is the most important part of the whole question.

When we take the river navigation into consideration in calculating the cost of water in the north-west, it entirely alters the case. In the above calculation of 7,300 cubic yards per rupee, we suppose that the water while in the river is of no value;

* As these sheets are passing through the press, we have accounts from India which express apprehensions of scarcity, if not famine, in the N. W. Provinces, in consequence of a failure in the periodical rains. This fact gives additional importance to the subject we are discussing.

but, in estimating the value of water for navigation in the Ganges, we find, as above shown, that it is probably worth not less than one rupee per 500 cubic yards. But, indeed, the real value of the water for this purpose cannot be truly calculated. It is not that the diminution of water in the river would add a million sterling to the cost of transit of the present traffic, but that such an increase of the cost would destroy a very large proportion of the trade. If the present traffic is on an average $1\frac{1}{2}$ millions of tons, and the average value of the goods is 100 rupees a ton, the total value is 15 millions sterling. An increase of cost of transit of a quarter, or from 20 to 25 rupees, might very possibly take off the profit of one-half of the goods, or reduce the traffic to the amount of $7\frac{1}{2}$ millions sterling. It seems highly probable that the profit on one-half of the goods does not exceed five rupees, or 10*s.* a ton.

When we therefore add to the cost of leading the water from the river its value for navigation, it seems almost certain that its abstraction from the river, excepting in case of famine, is the gain of a loss, unless the canal were continued to Calcutta This point must be further considered hereafter.

Captain Smith further supplies the following data for estimating the *value* of the water in the northwest.

He reckons the increase of produce due to irri-

gation at 640 lbs., or $10\frac{1}{2}$ bushels, at $\frac{3}{4}$ rupee a bushel, or eight rupees' value per acre for one crop; and allowing a similar increase for the other, it makes 16 rupees an acre per annum; and as the consumption of water is $\frac{2}{3}$ cubic yards per hour, or 6,000 cubic yards per annum, the value of water would be one rupee for 400 cubic yards, supposing that the irrigated cultivation entails no expense more than that of land not irrigated. No data are supplied on this point; but even if we allow for the expenses of cultivation so large an addition as six rupees an acre, it would still give the value of water at 600 cubic yards per rupee. There is, however, a difficulty here, for the Government water-rent is only one rupee per acre; and if we reckon that there is a clear annual profit to the cultivator of ten rupees an acre, the Government charge seems to be disproportionately small. With so great an advantage over the unirrigated lands, it would appear as if there could be no competition between the two.

Upon these data, however, we have 600 cubic yards per rupee, for the value of water for irrigation in the North-West Provinces, against 500 per rupee in Madras.

We have now, however, to reckon the additional value given to the same water, by its being used for navigation in the canal. If, as originally planned, the canal be continued to Allahabad, there will be

450 miles of navigation in one line. The present traffic by the river is estimated at a million tons, and the cost is about four pice per ton per mile. This would make the total expenditure on this transit 90 lacs of rupees. I have no doubt that in the canal, with towing-paths, and a current in the direction of the main trade, and an ample depth of water, so that large vessels could be used, this transit would not cost more than ⅛ pie a ton. On the Mississippi, with money of one-tenth of the value it is in the north-west, the charge is sometimes one pie a ton. The cost on the Rajahmundry canals is, at present, one pie or 1¼ pie, though they are far from being in complete order, and this is for very short trips; but for trips of 200 or 300 miles, the cost there would not exceed ½ pie a ton. The saving, therefore, by using the canal instead of the river, would probably be 3½ pice per ton per mile, or nearly 80 lacs a year on the whole traffic, and this divided among 8,000 million cubic yards, gives 1,000 cubic yards per rupee for the value of water for navigation, in addition to that for irrigation.

But even this does not give its full value. If the cost of transit were reduced to one-eighth of what it is at present, a very large increase would take place in the traffic. If the canal were continued to Calcutta, this increase would be immense; but even if it only extend to Allahabad it will be very great, and we may safely allow for the profit on this new

traffic half the sum saved on the old traffic, which would make a total saving of 120 lacs, as the return for 5,000 million cubic yards of water, or 660 cubic yards per rupee.

It must, however, be observed, that this supposes no increase of cost of transit to take place in the lower Ganges from the abstraction of water, or that some means are found to compensate for the latter. It is evident, that as so large a portion of the upper Ganges traffic either goes to or comes from Calcutta, whatever increases the cost of transit in the lower Ganges will check the traffic in the canal above Allahabad.

There cannot be a question that if the canal were continued to Calcutta, making the total cost of transit for 1,000 miles ½ pie per ton per mile, or 2½ rupees a ton for the whole distance, several million tons a year would be added to the traffic, and the trade of the port of Calcutta would be increased manifold. No system of railroads could possibly produce such effects, because they could probably never be worked at less than four times the cost of a canal.

If we now add together the value of the water in the Ganges canal for irrigation, viz., one rupee for 600 cubic yards, and the value of the same for navigation, viz., one rupee for 660 cubic yards, it makes the total value one rupee for 315 cubic yards. And this shows the great economy of making irrigating canals navi-

gable in this country: in this case it just doubles the profit upon the expenditure.

Perhaps wherever a fresh water canal is made for navigation, it would be advisable to use it for irrigation also; as there can be no question, that where one is made for irrigation primarily, it should be made navigable.

If to the above calculated value of the water for irrigation in Rajahmundry, we add that for navigation, in the same manner as I have here estimated it for the Ganges canal, the calculated results of that undertaking will be greatly increased. There will be at least 1,000 miles of navigation connected with the Annicut. We have, at present, no sure grounds for estimating the traffic over the whole. In some of the principal channels it is now about 4,000 tons a month, or 50,000 tons a year. But as yet no part of the district has been put fully in order, and not half of it has yet received water; so that the traffic is a mere trifle of what it will be, if the Delta continues to prosper. Probably the main channels will, before long, have a traffic of 200 tons a day, or 60,000 tons a year, and the average of the whole may be half that, or 30,000 tons a year; making a total of 30 million tons carried one mile, which, if carried by land at two annas a ton, would cost about 40 lacs; and when carried by the channels it will not cost, at the utmost, more than one pie per ton, or in all 1½ lacs, producing a saving of 38½ lacs on the

whole, and this divided over 6,000 million cubic yards, gives 2,600 cubic yards per rupee. It is quite evident, that this way of estimating the gain by navigation must give it far too low; while it is impossible to calculate the real extent of the advantage obtained by enabling the people to grow things, which, but for cheap transit, would be unprofitable. Taking the mean distance from the point of production in the Delta, to the port or place of consumption within the district, or to the boundary, if exported by land, at fifty miles, the saving per ton by water transit would be about six rupees a ton. So that, by means of the canals, a vast trade might be carried on in those things which, having to be carried by land, would be quite valueless unless consumed on the spot. We must therefore be far below the mark in allowing an additional value of one rupee per 2,600 cubic yards, as given to the water by the use of it for navigation, making the total value of it about one rupee for 430 cubic yards.

A curious confirmation of the above estimated value of water for irrigation is found in the case of a poor man who had a small garden, which he cultivated and watered himself. His time was equally divided between the two, and he earned two annas a day by the produce. He raised the water sixteen feet, and used seventy cubic yards in two days; his gain being two annas a day, makes the value of the water to him 560 cubic yards per rupee. If instead

of raising this water himself at the cost of a day's labour, he had obtained it from the Government, who, by providing it on a large scale, could have supplied him with 30,000 cubic yards per rupee,—he might thus have had the seventy cubic yards for $\frac{1}{400}$ rupee, or $\frac{1}{2}$ pie, that is, for one-fiftieth part of what it actually cost him.

We thus find that upon a large scale water can be provided in India for one-fiftieth part of what it is worth; that Government do actually obtain it at about 30,000 cubic yards for a rupee, and that when applied to the land and to navigation, it is worth at least one rupee for 500 cubic yards.

Is it then surprising that, on an average, all the new works of irrigation executed in Madras within the last thirteen years yield 100 per cent. to Government in direct revenue, besides that which is obtained indirectly, viz., by the increase of duties arising from the improved condition of the people; or that in Tanjore $1\frac{1}{2}$ millions sterling has been added to the saleable value of the land, since the construction of the Colleroon weirs? Those works were executed in 1836, and up to the present time there has been expended on them, and on various other improvements in the Delta of Tanjore, perhaps 10 lacs (besides the outlay for necessary repairs), and the revenue has increased from 42 to 52 lacs. The increase of value of land has been, so far as I have been able to ascertain, from about 20 rupees an

acre to 40 or 45, making a difference on 700,000 acres, of at least 1½ millions sterling; and I think this is below the actual present price. The result of this expenditure of 10 lacs, or 100,000*l.*, may, therefore, be thus calculated:—

Capital represented by an annual interest of 100,000*l.* at four per cent.	2½ millions.
Increased value of property . .	1½ „
	£ 4 millions.

And the increase of value given to the land is yielding from five to six per cent. Thus this outlay of 100,000*l.* has produced the interest of upwards of four millions; or, the value of the water is more than forty times its cost. After many examinations of this case, I feel confident that this is a true calculation, and no exaggeration, and it remarkably agrees with the former calculations of the cost and value of water taken from other data.

Now if a community can purchase water at a certain price, and sell it again in the shape of rice, sugar, indigo, tobacco, pulse, cotton, &c., in unlimited quantities, for fifty times as much, one would suppose that the question of how to make both ends meet was settled. Such is, undoubtedly, the actual state of things in India. The price of all exportable articles, whether rice or cotton, for instance, is

equally made up of the cost of food and clothing. And if water be applied to diminish labour, in raising articles of food, the portion of the population thereby set free will of course employ themselves in raising whatever their country is best suited to produce for foreign countries, and any amount of cotton and other things can be sold to Europe, China, &c.

Port Phillip has been loaded with wealth by discovering a thing which can be obtained at one-fourth its value, while India continues poor with a thing which can be obtained at $\frac{1}{40}$ of its value. What is the difference between the two countries that produces such a strange anomaly? The sole reason is, that the Port Phillippians make use of their treasure, which the Indians, or rather their European rulers, do not. A man in Port Phillip, who could earn previously 40*l.* a year on an average, went to the diggings, and obtained in one year about 140*l.* worth of gold. As soon as this was known, more than half the population were employed in digging gold, and the first year they obtained about 14 millions sterling. In India, supposing that at this moment 25 lacs a year are being spent on new hydraulic works, we may calculate that about 60,000 people are so employed, or not more than $\frac{1}{2500}$ part of the population, and not a thousandth part of the proportion employed in Port Phillip, in securing the treasures there discovered.

Nothing, therefore, can be more evident than that

it is not the having a treasure in the country that makes it rich, but the taking every advantage of it. It was not the gold under ground that made Port Phillip rich, for it was not a bit the better for it for many years, but the digging it up and giving it in exchange for consumable things, &c. In the same way India will continue poor, even if water were ten times its present value, as long as it is not made the best use of, but still allowed to flow into the sea by millions of tons per second. The water that flows off in this way in an hour, by the Godavery, is sometimes as much as 4,000 million cubic yards, and it is worth 80 lacs of rupees, or three times the whole revenue of Rajahmundry for a year; but till it is made use of, the country continues just the same as if it had no such treasure.

How strange it seems, that whilst the dullest labourer can perfectly understand the value of gold, the wisest statesman cannot perceive the value of that which is exchangeable for gold, so that though a hundred pounds' worth of gold, in the form of water, can be obtained in India for 2*l.* 10*s.*, no Indian statesman has yet been found wise enough to set a thousandth part of the population at work to obtain it; whereas, in Port Phillip, when it was discovered that 100*l.* of gold could be obtained for 25*l.* worth of labour, more than half the population were immediately employed in digging it up. Whenever this subject is started, the defence is, "But see

what we are now doing; look at the Ganges canal, and the Godavery, and Kistnah works." Suppose the Port Phillippians had continued as poor as they were, and upon somebody taunting them with neglecting their great treasure, they were to say in defence, " what shameful misrepresentations ! out of our 60,000 people, we have got twelve people digging at Ballarat, and twelve at Mount Alexander," what should we think of their sense and activity? Yet twenty-four diggers bear the same proportion to the population of Port Phillip, as the 60,000 employed in hydraulic works bear to the whole population of India.

Upon what imaginable principle is it then, that only certain parts, or three or four districts out of 100, are to be thus improved? The objection of want of money has been shown over and over again to be without a vestige of foundation. Did the Port Phillippians wait till they were rich before they went to the diggings? How many of those who traversed the country to reach the spots where this treasure was known to be, had any surplus cash? They went there because they were poor, not because they were rich. The case is exactly the same in India. How much surplus revenue has it taken to furnish Rajahmundry with hydraulic works? While 20 lacs have been spent, 30 have been obtained. The same with Tanjore. While 40,000 rupees a year were spent, a permanent increase of revenue of 40,000

rupees a year was obtained, so that in ten years, four lacs had been paid and 20 lacs received. How astonishing it is then that in the face of these notorious facts, this plea of want of money should be continually advanced without shame, just as if nobody knew of them.

There is only one district in the whole Indian empire (Tanjore) that has never, for more than twenty years past, caused the Government an anxious thought about finance; that has, from the first, up to the present time, been a source of real satisfaction in this respect, about which nobody has ever had to say, "how shall we make both ends meet?" and that has even provided, in its increase of revenue, ten or twenty times its share of the war expenses of India. And this is the only one where money has been spent throughout in increasing its supply of water. Has this district, in any one single year, been a drain on the treasury? Has any one yet been heard to say, "These are certainly grand and profitable works, but how can we find money for them? No doubt at some future time they will pay well, but in the meantime what possible contrivance can we discover to enable us to provide the money?" Nothing of this sort has ever been thought of. The district itself has, throughout, provided the money for everything, from year to year, and an enormous surplus besides. And yet the moment it is proposed to do the same thing in the next district, it is said,

"these ruinous wars keep us so poor that we cannot afford it; and not only so, we cannot even afford to have the old works kept in repair." For there is not a district in the Madras Presidency, except Tanjore, in which the old works are all in good repair.

It is not the ruinous wars that have kept us poor, but the most unaccountable neglect; a neglect the more extraordinary because it is not endured for a moment in other things. Let any man propose to provide money for wars, by leaving buildings to go to ruin, and he would be thought mad; and yet this is only what is systematically done with works upon which the food of the people and the revenue depend.

India is like the field after an Indian battle; there is but one cry, "water, water." All that is wanted is water; and this want supplied, everything else will almost follow of course. Water for irrigation, and water for transit, will provide for everything else. Water is the universal solvent, and can solve that which has puzzled all the Indian wise men from Lord Cornwallis down to the present time, viz., the Revenue Settlement question. *It has solved* that question in Tanjore, the only district where it has been tried. When a man has to pay only six rupees a year for an acre of land, saleable at 45 rupees, the question is substantially solved. There may be, of course, a thousand questions of

trifling importance about that, as there are about everything else, but the essential difficulty is gone. The real difficulty all along has been this, how to get six rupees of revenue out of land on which the total profit was only five, and nothing but water could solve this; and it will assuredly do the same in every district of India where it is applied, by the simple process of making the profit on the land 10 or 15 rupees per acre.

The total amount of treasure in the country in the shape of water may be thus calculated. If we allow on an average two feet of rain to run off the face of the country annually, then, after allowing for evaporation, there will still be two millions of cubic yards available per square mile, besides what falls on the ground under cultivation, of which of course the profit is not lost. Thus the water that flows off every square mile is worth, at the rate of 500 cubic yards per rupee, 4,000 rupees a year. The present population of India averages about 100 per square mile; but if the whole of the water that falls were made use of, no doubt the country would bear at least 400 to the square mile. The water then turned to account would be worth 10 rupees a head per annum; and as there would be in all India 600 millions of people, the total value of the water would be 60,000 lacs a year, or 600 millions sterling.

Again, allowing that 7,500 cubic yards per acre

would be sufficient for a rice crop, and 2,500 for what are called dry crops, and that one-fourth of the country is cultivated with rice and three-fourths with other crops, it would take on an average 4,000 cubic yards per acre, which would allow of 500 acres being cultivated in every square mile, which is no doubt the part of the whole country that is fit for culture.

With the present population, one-fourth of the whole of this water might be turned to account, and by that means a clear additional income of 150 millions sterling obtained, or six times the whole present revenue. Hence we see how utterly insignificant, as compared with its income, would be the cost of governing the country, provided that what has been done in Port Phillip were done in India; that is, if the treasure we possess were made use of.

Can anybody assign any reason why the same that has taken place in Tanjore should not take place in every district if the same means were used? That district is yet by no means improved to the fullest extent, and yet the population has doubled within perhaps twenty-five years, and is now about 500 per square mile. Were water generally throughout the country thus made use of, the population would certainly increase as fast everywhere. So also the state of the people there has greatly improved in respect of their physical circumstances; and this also would be universal.

We may next examine more particularly the state of the question as respects the use of water for navigation. This involves the great question of the comparative value and importance of internal navigation and land communications, especially with reference to India. Not a single paper has yet been written about canals and railways in India that does not show a fundamental misapprehension of this subject. Universally railways are spoken of as substitutes for canals, though nothing can be more false than this idea. Canals, as at present worked, even where steam is not used, are the cheapest of all communications; but railways afford the highest speed. There is not the slightest probability of railways ever beating canals in cheapness, nor of canals beating railways in speed. This at once reduces the question between the two works to this, — Which in any particular circumstances is most required, speed or cheapness? or, in other words, Which is the most serious loss, that of time, or that of the increased cost of transit? Or, again, Is the time saved by a railway purchased at more than its real value, considering the extra cost of transit? A very simple calculation will show this may be the case. Suppose goods carried by a railway 1,000 miles in three days, at fourteen miles an hour, and the same by a steam-canal at three miles an hour, night and day, in fourteen days — the loss of time is eleven days. Now if these goods are of

the value of 3*l.* a ton—grain, for instance—the loss in interest at eight per cent. for eleven days is 15 pice, or 2*d.*, which is equal to $\frac{1}{70}$ pie, or $\frac{1}{800}$*d.*, per ton per mile. Now if the railway is worked at four pice and the canal at one pie, it is clear that an addition of three pice is paid for a benefit of the value of $\frac{1}{70}$ pie, or we pay for our whistle 200 times what it is worth. This is quite sufficient to show that railways are not substitutes for canals, and that to talk of these latter as the substitution of a second-rate for a first-rate means of commercial intercourse, as is so universally done, is a complete mistake; it is exactly as if we should insist that no more carts should be built because carriages had been invented.

Thus the question is an open one still, Under such and such circumstances, what kind of communication is most suitable?

Before going further, however, it will greatly help us in investigating this most important point, if we consider the most obvious oversights which are observable in the mode in which this subject has hitherto been treated.

The first is, that all our ideas on the question are based upon the two kinds of works as seen in existence in England. Thus we compare canals constructed for 10,000*l.* a mile before steam and the value of time were discovered, with railways costing 45,000*l.* a mile, and arranged to be worked by steam, and to economize time to the utmost. But

how does this settle the question of adopting a new system of communication, in which, of course, the power of steam would be adopted in both?

In England, moreover, the only canals at present in existence are winding ones fitted with confined locks, which take a long time to fill and empty, are often closed for weeks by frost, and always worked at two or three miles an hour by horse power. And yet, with all these enormous disadvantages, are the railways a substitute for the canals? Not at all. All the great lines of canal are in full operation to this day, and are, I believe, without exception, yielding much larger profits on their cost than any railways. What is the actual amount of traffic on any of the English canals I have not the means of ascertaining; but when we see by Lardner's Treatise that the goods traffic on the railways varies from 68 to 631 tons a day, it is quite certain that the great bulk of goods must be still carried by the canals. And when it is considered that railways, although having the prodigious advantage of steam power in their favour, yet carry so small a proportion of the traffic, nothing can be more evident than that railways cannot be substitutes for canals.

If we wanted fully to compare railways and canals, we should consider how the case would stand even in England if a new canal perfectly suited to the use of steam powers were now cut. I will not take the

cost at 45,000*l.* a mile, like the great railways (or 4½ times their actual cost), but at 20,000*l.* or 30,000*l.* a mile, the canal with few windings and capacious locks, capable of being filled and emptied in a few seconds, and capable of being navigated by screw steamers of 300 tons, or of 300 horse power, for passengers: and we should then see a real comparison between these two classes of communication in England. It seems almost certain that a railway on the same line as such a canal would not obtain employment enough to pay one-tenth of the interest of its cost; because passengers could be conveyed by the canal at fifteen or twenty miles an hour, and the great mass would be conveyed with a speed of ten or twelve miles an hour, at so very low a cost as to leave probably only the very highest class of passengers for the railway. And goods would be carried at such a speed as would best suit each kind.

Thus in comparing canals and railways, we take our ideas from the state of things in England, where there is steam power on one side, and animal power on the other, besides many other disadvantages in the canals,—such as frost, a very winding course, locks very slowly filled, &c., which are no necessary part of a system of inland navigation, and would not be met with here.

2nd. We have lost sight of the effect of long distances upon transit. In England, according to Dr. Lardner, goods in general are carried by railway

on an average 22½ miles. There, of course, cheapness forms a far less important item than in a country where goods are carried, on an average, 100 to 1,000 miles; but even there cheapness is so important a point that, as we have already seen, the great mass of goods is taken by the cheapest means of communication, although at a lower speed. But in America and India, all other points are comparatively insignificant as compared with cheapness. In England, a thing costing 40*l.* a ton is carried the average distance of 22½ miles at the rate of 2*d.* a mile, whereby only 3*s.* 9*d.*, or less than one-half per cent. is added to its cost, and if conveyed at 1*d.* a mile, the addition to its cost would be only 1*l.* in 400*l.* But if, in India, an article worth 10*l.* (a high value for the common articles of transit here) be carried 500 miles at 2*d.* per mile, more than 4*l.*, or 40 per cent., is at once added to its cost; and if carried 1,000 miles, 80 per cent., or 8*l.* Even if it could be carried at 1*d.* a mile, it would still make an addition of from 2*l.* to 4*l.*, or from 20 or 40 per cent. to the first cost. And as the difference of ¼ per cent. often makes a difference in the demand for an article, the reduction of even a tenth part of the above 20 or 40 per cent., may easily make the difference of a vast demand for an article, or none at all.

Hence we see, that though the question wer finally settled in England, it would by no means

close it for India, even if there were only this one point of difference.

3rd. The question has never been discussed in England whether railways or canals should be constructed.

The question there was, whether railways should be *added* to other means of communications, and therefore the two cases are totally different. The country was already provided with a complete system of *cheap* communications, and the only question was, whether it could afford to add to them a system of costly high-speed communications. England could much better do without its railways, than without its canals. If the canals were destroyed, the railways could not, in their present state, carry on that traffic which is indispensable. If the high-speed trains were continued, then, in order to accommodate the mass of traffic now carried by canals, additional lines of rails must be laid down, at a far greater cost both in capital and current expenses than canals could be cut for.

Hence again, even though it were clearly proved that people were right in adding railways to canals in England, this does not decide the question, whether in a country without either roads or canals, we should first construct railways.

4th. The amount of traffic has been totally lost sight of. The busiest railway in England only

carries 630 tons a day; the ten principal ones, on an average, only 288 tons, and the average of the whole is probably not as much as 200 tons. How then can this settle the question for a traffic of 7,000 tons a day (like that in the line from Calcutta to the interior), which will undoubtedly increase to 20,000 tons, when the country is improved, as it now soon will be. We might as well say, that because my lord and his lady find a carriage sufficient to carry their own persons, therefore all the farmers in the state ought to carry their hundreds of tons of goods in gentlemen's carriages, instead of in waggons. It by no means follows, that because a railway answers for such an insignificant traffic as that conveyed by it in England, it would therefore be sufficient or suitable for the enormous traffic of India, even in its present paralyzed state. It is quite clear, that if a double railway had to convey 100 trains a day of 100 tons each, they must at least all go at one speed, and I suppose it would be found absolutely necessary, in order to allow of the necessary repairs being made, to have a third way; so that, if fast trains were also to be used, the railway must have five pairs of rails, which, in England, would cost on an average 100,000*l.* per mile. But if we only consider what the effects of occasional accidents would be on a line worked by 100 trains, it appears more probable, that a railway with five

pairs of rails could not anything like perform the work of a line of traffic of 1,000 tons a day, besides quick passenger transit.

The question, therefore, still remains open, viz., What kind of communication is best for a country with such an enormous traffic as we have to expect and provide for in India?

5th. In England, the time occupied in constructing was a comparatively unimportant consideration. Up to this time, perhaps 7,000 miles, including a great length of secondary lines, have been constructed; and in the meanwhile, the country had the use of a complete system of common turnpike roads and canals (about 100,000 of the former, and 5,000 of the latter, I believe), besides sea and river communication within fifty or sixty miles of every point in the country. In India we want at least 20,000 miles of main line, and 100,000 of secondary, or fifteen times the length required in England, and have, in the mean time, no cheap and moderately expeditious means of transit, excepting one single internal line, that of the Ganges, and the coast line of the Peninsula.

The question of communications is thus a vital one to India.

It is not like the railway question in England, which was merely the introduction of a great improvement, when the main interests of traffic had been substantially provided for. Rapidity in the

execution of a system of communications is here the great fundamental point of the whole question; twenty years were occupied in laying down the principal railways in England; but as India cannot afford to wait 300 years in providing herself with the corresponding 120,000 miles of communication she requires, India *must* find some more expeditious way of proceeding.

6th. England has no internal facilities of any importance for forming internal water communications; having only a few short lines of improvable rivers. India, on the other hand, has a vast extent of rivers, capable of being made perfectly available for steam navigation throughout the year, at a cost not exceeding one-fiftieth of what railways will cost, and, consequently, capable of being brought into use in, at most, one-fiftieth part of the time that it would take to execute the same extent of railway. Thus, we have, in several lines, the choice between opening in one year 300 miles at a cost of 1,000 rupees per mile by improving a river, and constructing a railway in twenty years, at suppose 50,000 rupees a mile. The *most* important lines can all be opened at once by the above trifling expenditure of time and money. What madness, then, to throw away our immense natural advantages, merely because another country was compelled, for want of such advantages, to incur enormous loss of time and money.

7th. The false impressions respecting canals, as compared with railways, have arisen, in part at least, from what, upon a little further inquiry, proves to be one of the strongest things in their favour, viz., the alarm, or actual loss of canal proprietors in consequence of the competition of the railways. What placed them in this predicament was, the enormous profits on the canals, some of which, I believe, yielded 50 per cent. or more upon their original cost, and in consequence their saleable value rose to five or ten times that cost. Thus, the modern shareholders paid perhaps 2,000*l.* for a share which originally cost 200*l.*, and it was necessary, in order for them to get five per cent. for their capital, that the canal should yield 50 per cent. upon its cost. Of course, a concern in such a predicament was in danger from any new competing work; and a new canal would have ruined the shareholders as effectually as a railway. When the profits on a work are great, the market value of shares corresponds, and if a work which cost 10,000*l.* a mile has to provide interest for 100,000*l.*, it must need contend at a tremendous disadvantage with a new work, which has only to provide a profit on its actual cost. The abstraction of a small proportion of the traffic may easily reduce the profit to the present shareholders below that of the national interest of money, or, they may be deprived of half their income, while still the great mass of the traffic is conveyed by the

canal, and the profits of the work are 25 per cent. upon its actual cost. The mere fact, therefore, of a new work injuring the property in the other, or even ruining the owners, proves nothing as to the superiority of one to the other.

8th. Further, the settlement of the question between railways and water communications in England would not tend to decide anything in India, for another century at least, on account of the difference in the nature of the surface. Wherever the variations of level are great, the advantage is proportionately in favour of the construction of railways as compared with canals. There is no comparison between the surface of the country in England, and that in India. The amount of work required on a given length of communication in India is not one-tenth of what it is in England, taking the main portion of India. Hence, on many lines, a canal may be almost as straight as a railway, and the work of constructing it altogether would not be more than that of preparing the line for rails. On many lines, a steam canal could be made for a tenth of what a railway would cost.

It must be observed that all these remarks refer *to high-speed railways*, such as are now talked of for India, and are under construction.

9th. In England the comparative cost of earth, masonry, &c., and of iron and machinery, is so totally different from the same in India, that on this

ground also, any conclusion reached by means of the data in the former, cannot be trusted to for India. If rails there cost 6*l.* a ton, and earth 1*s.* a cubic yard, while in India the latter costs 1*d.*, and the former 8*l.*, it is evident that whilst in England a canal may cost one fourth the expense of a railroad, in India it may cost only one-tenth, without making any allowance for the difference in the surface of the country.

We may thus sum up the points which have been hitherto almost lost sight of, with reference to the use of water communications in India.

1. Steam.

2. Distance.

3. Railways as the only communication, or as an *addition* to a system of canals.

4. Amount of traffic.

5. Time occupied in constructing a system of communications.

6. Improvement of rivers.

7. Cost of canals in England as compared with present value.

8. Comparative nature of the surface in India and England.

9. Comparative cost of iron, &c., and of labour, in India and in England respectively.

We thus find that the state of things in England affords no data for the decision of the question respecting the use of water in Indian communications

in most of its fundamental points; and consequently, if we trust to our preconceived notions in this case, we shall most assuredly be quite wrong in our conclusions. There are, in the first place, no steam water communications of any consequence in England. There are such, however, both natural and artificial, in America; in the case of the Hudson, we have 160 miles from Albany to New York. On this line, Mr. Mackay informs us—vide Mackay's "Western World"—that a barrel of flour is conveyed for 2*d.*, including landing, &c., which is equivalent to $\frac{1}{7}$*d.*, or a little more than one pie per ton per mile. And if this can be done in America, with the low value of money there, it could certainly be done in India for $\frac{1}{4}$ pie, or $\frac{1}{32}$*d.* per ton per mile. Compare this with the proposed railway prices in India, varying from 1*d.* (or eight pice) to $2\frac{3}{4}$*d.* (or 22 pice), and the great difference will at once be made clear. As regards speed, the Hudson line is generally worked at eighteen and twenty miles an hour, with steamers drawing four feet, and we are perfectly certain that this speed will go on increasing. Thus we have an actual case of inland steam navigation, with a very small depth of water, a speed of eighteen or twenty miles an hour, and a cost for goods corresponding with $\frac{1}{4}$ pie in India. The common charge, too, for first-class passengers, is half a dollar, or one rupee, equal to $1\frac{1}{4}$ pie, or $\frac{1}{6}$*d.* per mile. Can any man be found to deny that such a commu-

nication would be immeasurably more valuable for India, than one on which the very few first-class passengers could travel at forty miles an hour, but on which the great mass of travellers and the whole amount of goods must pay ten or twenty times as much as need be charged on a navigation line?

Again, Mr. Ellet states, that goods are sometimes carried on the Mississippi for $\frac{1}{8}d.$, or one pie per ton per mile; and although he does not state the general rate, it would doubtless not be much more than that.

Of artificial steam navigations, we have that of the St. Lawrence and its canals. On this line, according to Mr. Mackay, the charge is 2*s.* 4*d.* for a barrel of flour of 200 lbs., carried 650 miles, which gives $\frac{1}{2}d.$, or four pice a ton a mile, which includes canal dues; and he also states, that after some further improvements, this charge will be reduced to about $\frac{1}{3}d.$, or $2\frac{1}{2}$ pice a ton. This traffic is carried on by 300-ton screw steamers, at $6\frac{1}{2}$ miles an hour, night and day, including stoppages. The above charge corresponds with about half a pie in India, or even less, allowing for the difference in the value of money; and at a speed of three miles an hour, it would not cost half of that.

Thus, undeniable proofs are given us, upon the unexceptionable authority of Mr. Mackay, of the value of inland steam navigation, both with respect to the grand fundamental desideratum in transit

cheapness, and also with respect to speed. But even were it otherwise as regards speed, it is most certain that in the present state of India, no speed in the world could make amends for the cost of transit of goods being increased eight or ten fold.

We have next, from the same authority, some account of the navigation by the Erie canal, from Lake Erie to Albany, on the Hudson, 365 miles, worked by horses. This canal was first cut in 1822, for about seven million dollars, or 150 lacs of rupees; and in 1840 (ten years after the value of railways was clearly seen), its enlargement was commenced and carried out at a cost of 24 millions more, so that its total cost has been 31 million dollars, or about 1,80,000 rupees a mile. Lardner, in his account, makes the cost 1,37,000 rupees a mile. The average cost of railways in the States is given by the same authority at 81,000 rupees a mile, so that even after the effects of railways were fully known, and several thousand miles had been constructed in the States, it was not thought a mistake to enlarge a canal, by spending on it three times its original cost, making a total per mile of more than 1½ times the cost of railway, and that, too, in a country where *the frost stops water communication for five months every year.* In a chapter entirely devoted by Mr. Mackay to the subject of the transit between the upper valley of the Mississippi and the Atlantic, in which he describes the struggle between the States and Canada

to secure its passing through each of those countries, railways are never once mentioned—a highly significant fact in connection with this investigation. The fact is, that railways do not, in the slightest degree, affect the question. Their usual charge for goods is 3*d.*, or $1\frac{1}{8}$ anna per ton, and even though they have the immense advantage of being open all the year round, while canals (in America) are only open for seven months, the whole question still turns upon the comparative advantages of the two lines of *navigation;* and Mr. Mackay shows, that Canada having steam power, the other has no chance with it. Dr. Lardner states that it was in contemplation, when he wrote, again to enlarge this canal, in order to allow of the use of steamers on it; so that it will probably eventually cost much more than double the railroads in America, and this after the fullest experience of the two kinds of communication. This leaves no room whatever for doubt, that it is a complete mistake to look upon a canal as universally and simply a second-rate means of communication, which ought never to be substituted for a first-rate one, like a railway. Here is an undoubted case where there cannot be the smallest question of the superiority of a steam-canal, or even one worked by horses, over a railway, and where the railway is constructed, not as a substitute, but as an addition, and *that,* no doubt, chiefly on account of the canal having been hitherto worked at three miles an hour by horses, and entirely

stopped for five months in the year. The cost of transit on the Erie canal line is stated to be $\frac{9}{10}d.$ per ton per mile, or seven pice (including tolls), which corresponds with about $\frac{1}{4}d.$, or $1\frac{1}{2}$ pice in India; but as out of this, interest on so large a sum as 1,37,000 rupees a mile is provided at $5\frac{1}{2}$ per cent., and by a traffic confined to seven months in the year, the actual cost of draft can be only a small part of the whole charge.

In speaking of the railways in the States, Dr. Lardner says, " But little merchandize is transported by them, the cost of transit by them being greater than goods in general are capable of paying." And in his tables he shows that the average distance that goods are carried by rail is thirty-eight miles, clearly proving that the great mass of the distant traffic is scarcely touched by railways, although they exist on many lines where there is no water communication. The fact is, that *where goods cannot be carried by water they are not carried at all, except for very short distances.* Let this be well considered in investigating the subject of communications for India. Dr. Lardner gives the average charge for goods in America at $1\frac{3}{4}d.$ per ton, corresponding with about $\frac{3}{8}d.$, or three pice, a ton in India, and *this cost is sufficient to prevent distant traffic.* Dr. Lardner also, in speaking of the Hudson navigation, carried on in steamers drawing at most only $4\frac{1}{2}$ feet, when the splendour and

magnitude of the accommodation is considered, the cheapness of the table, &c., it will be admitted that no similar example of cheap locomotion can be found in any part of the world. Passengers may there be transported in a floating palace, surrounded with all the conveniences and luxuries of the most splendid hotel, at the rate of twenty miles an hour at $\frac{1}{8}d.$ per head per mile, corresponding with about $\frac{1}{8}$ pie in India. If there were a line of steam-canal in India suited to steamers drawing $4\frac{1}{2}$ feet, worked at twenty miles an hour, for passengers at $\frac{1}{8}$ pie each, and conveying goods at $\frac{1}{8}$ pie per ton per mile, how much traffic would be left for railway on the same line?

We may further judge of what inland steam navigation may be from the statement of the expenses, &c., of the Austrian Lloyd's Company's Mediterranean fleet for 1852-3.

The expenses of their whole fleet of fifty-eight vessels for the year, while running 580,000 miles, was—

	Florins or rupees.
Pay, victualling, fuel, and expenses, &c.	2,100,000
Administration	300,000
Depreciation of vessels	70,000
	2,470,000
Dividend at eight per cent.	240,000
Rupees	2,700,000

which, divided over 580,000 miles, gives $4\frac{3}{8}$ rupees per mile per vessel, which, allowing four to one for the difference in the value of money in the Mediterranean and in India, is equivalent to $1\frac{1}{4}$ rupees per mile in the latter, including profit at eight per cent.

The sum of 2,40,000 rupees being interest at eight per cent., implies a capital of 30 lacs, or about 50,000 rupees, for the cost of each vessel; which may therefore probably average 100 horse power and 300 tons, allowing 30*l.* per horse power, and 6*l.* per ton.

The cost will then be per horse power per mile $\frac{41}{100}$ rupees = nine pice, equivalent to $2\frac{1}{4}$ pice in India.

And the cost per ton of vessel per mile $\frac{41}{300}$ rupees = three pice, equivalent to $\frac{3}{4}$ pie in India.

And this being the actual expense of working ocean steamers, which, allowing for the different cost of vessel and engines, the difference in the wear and tear, and other contingent expenses, must certainly be double that of working vessels of the same size and speed on inland waters; we therefore arrive at the conclusion that such vessels could be worked inland at the rate of ten or twelve land miles per hour, at ten annas per mile.

This will give a very clear idea of the difference that water communication by steam power would make in India,—a vessel of 300 tons and 100 horse

power, at ten miles an hour, costing exactly the same as two palanquins, or four bullock bandies. If there were such a communication from Madras through Tanjore and Trichinopoly (to which there is not the vestige of an obstacle), a gentleman and his wife might hire a whole steamer of 300 tons, and reach the foot of the "Nilgherries" in forty hours for the same money that they would now pay to go there by palanquin in eight days. Or if they could content themselves with merely a cabin to themselves, supposing there were only twenty first-class passengers who paid one-fourth of the total expenses (the rest being paid by second-class passengers and goods), they would have to pay only 1½ pice a mile each, or six rupees for both for the whole distance, instead of 250 rupees by palanquin.

And supposing the merchant who had to send 300 tons of goods to Madras paid half the hire of the vessel (the rest being paid by passengers), the goods would be charged at the rate of only ⅓ pie per ton per mile, or 11 annas per ton for the whole distance, or 200 rupees for the whole quantity of 300 tons conveyed to Madras in forty hours, instead of, as at present, paying the hire of 600 bandies, at one anna a mile each, total 15,000 rupees, to have it conveyed to the port in thirty days with much risk; so that what now is an unprofitable venture to a merchant would, with the steam-canal, give him a profit of 1,484*l.*

From such calculations as these, based on unimpeachable data, one cannot but see what India is losing for want of water communications.

It is remarkable how the above calculation from ocean steamers on an extensive scale agrees with the actual cost of working a 20-horse power steam-tug on the Godavery, viz., two annas per mile, or $1\frac{1}{4}$ pice per horse power per mile, just half the cost of the ocean steamers, after allowing for a difference in the value of money, four to one; and precisely the same, allowing for the difference of the cost of inland and ocean navigation, two to one.

Such a steam-canal could certainly be cut on the line above mentioned for 20,000 rupees a mile, making the most liberal estimate.

Now let us suppose, instead, a high-speed railway with double lines of rails (which would be absolutely necessary to accommodate the traffic) to cost only 70,000 rupees per mile; and allowing that it were worked at half the lowest rate estimated by the railway men, viz., four pice per mile, or twenty times the cost of working the canal, can there be any doubt which work should be selected? Ask the merchant which he would prefer, to go up to Coimbatore by canal in twenty hours, travelling at the rate of fifteen or twenty miles an hour, and send his goods back at 11 annas a ton, or to travel himself by the railroad in ten hours, and then send his goods back at 50 rupees a ton; and this, too, being only

obtained by an outlay of 280 lacs for the railway, whilst 80 lacs would suffice for the canal.

We find, therefore, abundance of undeniable data which leaves no possible room to question the suitableness of water communication to this and indeed all other countries, or its immeasurable superiority to any other means, until a country can afford to *add* communications affording a still higher speed. Moreover, we are not yet at the limit of speed by water; it has already exceeded twenty miles an hour in 4½ feet water, and nothing in the world is more certain than that it will go on increasing. The vessels on the Hudson, for instance, which have reached twenty-two miles an hour, would easily carry a second engine as large as the first, and then run at about twenty-seven miles an hour. And from the lately published accounts of the screw, it appears almost certain that the same power of engine working screws, instead of paddles, would give a much higher speed; probably at least thirty miles an hour, or half as much again as the average speed of the American railways.

Let us again suppose that the river navigation were to be improved to the utmost, so as to make all rivers with a fall of two or three feet a mile, and under as complete lines of navigation as possible. I have before reckoned that a stream of a million cubic yards an hour would secure a depth of three or four feet everywhere in the Godavery, and that

tanks containing 3,000 millions of cubic yards would be ample for this purpose, and would cost about 15 lacs. If treble this quantity were stored, so as to give a depth of full six feet, and the bed were perfectly cleared of rocks, so as to allow of the freest passage for steamers, then vessels of any power might be used, and I have little doubt that, if kept at this regulated depth, excepting during the freshes, it could be worked by night as well as by day; and if very high speeds were required, a mean current of suppose two miles an hour would be no obstacle to such vessels as would be worked. A vessel with a speed of twenty miles an hour, for instance, would go up eighteen and come down at twenty-two miles. The cost of storing 9,000 millions of cubic yards might be 45 lacs; and allowing five lacs to be spent on the bed of the river, &c., we should have half a million sterling as the cost of at least 700 miles of such navigation (besides making the same rivers available for small vessels to a much higher point), which would be at the rate of only 7,000 rupees a mile, against 20,000 for a steam canal, or 70,000 for a railway. And it would have this vast advantage, that in the very first year the river would be available throughout, and each year the whole navigation would be improved to the full extent of the amount expended. This is precisely what India wants, viz., to have whole lines of transit at once improved to a certain extent. If a high-

speed railway were laid on this line, it would be many years before the cotton country would be really accessible; and, in the mean time, at least ten times the whole cost of the work would be lost for the want of the means of transit. Five lacs laid out on the river would, in the first year, provide a thoroughly good and exceedingly cheap communication from the heart of Berar to the coast, while five lacs laid out on even a single high-speed railway, would provide for only perhaps 30 miles out of the 450; and if only 100,000 tons were carried per annum, there would be a loss of 50 lacs for every year that the opening of the communication was delayed.

This shows the real state of the case between the Bombay Railway and the Godavery. To reach the centre of the cotton country will require 400 miles of railway. What has already been done, has been at the rate of ten miles a year, and 70,000 rupees a mile; and continuing at the same rate, they would, but for the Ghauts, reach the Wurdah in forty years, after spending about 280 lacs on the road; and allowing only a traffic of 100,000 tons a year for half the time, or twenty years, at 60 rupees per ton, there would be an outlay of 1,200 lacs on transit alone. And the account would stand thus at the end of forty years, even supposing the trade did not increase on the Godavery, and that goods were carried for nothing by the railroad.

Railway.

400 miles at 70,000 rupees . . .	280 lacs.
100,000 tons per annum for twenty years, at 60 rupees a ton . . .	1,200 ,,
Total expenditure .	1,480 lacs.

Godavery.

Improving rivers to give a constant depth of six feet	50 lacs.
100,000 tons for forty years, at 3 Rs.	120 ,,
Total expenditure .	170 lacs.

But the railways expect to be able to carry goods at $1\frac{3}{4}$ annas per ton (equivalent to $2\frac{1}{2}$*d.*), which, for 400 miles, would be 40 rupees, or two-thirds of what it now is, in which case, 800 lacs more must be placed against the railway, making the expenditure on that line 2,300 lacs, against 170 by the river; or thirteen times as much as the latter. Even allowing the railway to be worked for nothing, there would be a difference of 1,200 lacs.

And this, too, supposes that the river traffic would *not* increase, whereas, probably before ten years were over, it would increase to 500,000 tons a year, if carried for five rupees a ton; and were the river improved to the extent above supposed, the rate of transit would not exceed one rupee a ton.

Even if we suppose the ghauts to cause no delay in the railway, and that it be henceforward carried on at three times the rate hitherto, that is, at a cost of about 20 lacs a year (a large extent of operation in India corresponding with 1,200,000*l.* in England), still it will take no less than thirteen years to reach the cotton country. And if we allow that the railway is worked at a quarter of the sum at present calculated by the railway projectors, or four pice per ton, equal to eight rupees for the whole distance, and that the Godavery is worked at from five rupees gradually diminishing to one, or at an average of three rupees, then the account for the thirteen years would stand thus:—

RAILWAY.

400 miles at 70,000 rupees . . .	280 lacs.
100,000 tons a year for 6½ years, at 60 rupees	390 ,,
100,000 tons at eight rupees . . .	80 ,,
Total expenditure .	750 lacs.

GODAVERY.

Improving river	50 lacs.
100,000 tons a year for thirteen years, at three rupees	39 ,,
Total .	89 lacs.

But besides this, the traffic on the Godavery may be fairly reckoned to have increased to 500,000 tons a year, while that on the railroad, being carried at eight times the cost, certainly would not, in proportion, have increased beyond 200,000 tons. So that after losing 660 lacs (6½ millions sterling), we should be left, in the one case, with a traffic of 200,000 tons, carried to the coast at eight rupees per ton; and in the other, with a traffic of 500,000 tons, carried at one rupee per ton; the extreme rate of transit being, by railway, perhaps forty miles an hour, against twenty by the river. I think this may fairly be considered paying too dearly for an additional speed of twenty miles an hour, for the very small proportion of passengers to whom this would be an object worth mentioning. I suspect that even those who advocate a high speed, would, when it came to the point, rather go at twenty miles an hour than pay the difference for speed.

This also entirely leaves out of view the extremely important point, that by the Godavery, Berar can be supplied with food from Rajahmundry at a quarter of the present cost; an advantage on the side of the river line which it would not be easy to overestimate. This would give a stimulus to the cotton cultivation almost equal to that caused by the cheap transit.

At the end of five years, when the railway would not yet have reached half-way up to Berar, even

allowing it to proceed three times as fast as it has hitherto done, the Godavery would have been a line of immense traffic for four years, every one of which would much more than pay for the whole cost of making it a six-feet navigation.

One would suppose that nothing could be more obvious, than that a country lying just half-way between the two coasts, with, on the one side, a river already navigable for six or eight months in the year (a longer time than the Erie canal, upon which the Americans have spent six millions sterling, or 180,000 rupees a mile), and on the other, a line of ghauts 3,000 feet high, which render a railway a very difficult undertaking—should rather be connected with the port to which the river flowed. But men can only hold one idea at a time; and if their brains are already occupied with that of a railway, it is impossible to force in that of a navigation too.

If parties who take an interest in this matter were to be landed at Bombay, carried twenty miles by the railway, and then on horses and in palanquins 300 miles to the Wurdah, a journey of from eight to twenty days, at an expense of 100 rupees each, and on arriving there placed in a steamer, and floated down to Coringa, in thirty or forty hours, for a rupee each, then they would probably return to England with a more correct notion of the real state of the case, particularly as on the way up they would have met thousands of worn-out bullocks and drivers, car-

rying cotton at the rate of ten miles a day, and a cost of 60 rupees per ton, whilst in the boats in which they descended the river, there would probably be 100 tons of cotton on freight, at five rupees a ton. Reaching the end of the railway, after a journey of twenty miles, when it had already been two years in progress, and then seeing the frowning ghauts immediately before them, would also be a highly instructive circumstance, which would tend greatly to clear their sight; and there would also be plenty of time for true impressions to be received while on their long weary journey of ten or twenty days to the Wurdah, through a country without roads, and across rivers without bridges. What a lively idea they would have of the advantage of inland steam navigation, long before they reached the Wurdah; and with what entire satisfaction would they resign themselves to the sofas in the steamer, and consider themselves as good as at their journey's end!

I should mention that the river lies through, or near forest country all the way, so that firewood could be obtained everywhere at the bank of the river at half a rupee or less per ton (equivalent to about $1\frac{1}{4}$ rupees for coal), so that a hundred horse-power steamer would cost about three annas for fuel per mile, going up stream, and she would never have to carry a large quantity. Coal, also, has been found at two spots, and it is supposed to exist at a third, which the natives have hitherto contrived to conceal

from Europeans. Besides the effect of storing water in these tanks on the navigation and irrigation, other points will be gained by them. First, 3,000 million cubic yards retained in the tanks, would lower the water of the Godavery in the Delta, during floods, one foot per 500 hours, or twenty-one days; and as the floods never continue at their highest more than eight or ten days, these tanks would probably keep the river a foot lower than otherwise on such occasions, which would greatly diminish the danger to the embankments, and the extent of mischief in case of breaches.

A further value would be given to the water, by its use for water-power in the Delta. After entering the minor irrigating channels, it will fall thirty-three feet to tide-water, and allowing one-third of this on an average as available for power, 1,200,000 cubic yards per hour will provide 7,000 horse power for the whole twenty-four hours, throughout the year, reckoning by the standard of 33,000 lbs. through one foot, for a horse power. But as good steam-engines now usually direct a force of 60,000 lbs. for every nominal horse power, the above quantity of water and extent of fall will give only 4,000 horse power, assuming the present usual nominal horse power of steam-engines as the standard of measurement.

This amount of power available for the whole twenty-four hours, would be equal to the daily work of 42,000 pairs of bullocks, allowing their effective

work to be 16,000 lbs. per minute, and time of labour eight hours per day. The value of this, at five annas a day per pair of bullocks, would therefore be 13,000 rupees a day, or more than 40 lacs a year, besides rendering unnecessary the providing of a capital of 12 lacs for the purchase of the bullocks.

If the comparison is made with steam power, it would cost about 20 lacs to establish engines of the united powers of 4,000 horses, and they must be worked night and day. And the cost of working them in that locality would be about eight lacs a year, allowing wood-fuel at one rupee a ton, and including wear and tear, as interest, &c. The cost of steam power, calculating upon large engines, would not exceed one-fifth of the cost of bullock labour. This is the value of the water power throughout the year; but only a third of it will be the effect of the 3,000 millions of cubic yards supposed to be stored in tanks for the purpose of improving the navigation, and therefore only the sum of 2½ lacs a year should be credited on this account.

But it is evident that here, also, the money difference is far from correctly measuring the value of this water power, inasmuch as it would be much more convenient than steam, both by rendering unnecessary the erection of steam-engines, at a cost of 20 lacs, and also by the great superiority of water

over steam power, in its certainty, manageableness, and safety.

The water stored in tanks would thus be of value in four different ways.

1st. As lowering the river in floods, and thereby diminishing the risk to the crops and other property in the district, which however cannot be measured in money.

2nd. In improving navigation, which has been calculated at one rupee per 200 cubic yards, or 150 lacs for 3,000 millions.

3rd. In irrigation during the dry months, which, calculated as above, at one rupee per 300 cubic yards, gives a total of 100 lacs.

4th. For water power in the Delta, calculated as above, at 2½ lacs a year.

Thus we have more than 250 lacs as the total value of this 3,000 million cubic yards, when fully employed; while the cost of storing it at 28,000 cubic yards per rupee would be 110,000 rupees a year, or a little more than one lac.

Now let us stop a moment to consider, what we may, I think it will be allowed, fairly expect to be the effect, in the basin of the Godavery, of thus turning to account this invaluable treasure, water.

We have at present a vast extent of country on the Upper Godavery, about 120,000 square miles, occupied by perhaps 100 inhabitants to the square mile, who are almost cut off from the products of the

coast and from foreign trade, by a cost of transit of 50 or 60 rupees a ton. They can grow most beautiful cotton cheaper than any country in the world, and have thus in their possession one of the very first desiderata of the wealthiest country. Of this they at present sell about 20,000 tons, worth 40 lacs, and the produce of about 700 square miles, or $\frac{1}{170}$ part of the area of the basin, while England is ready to buy of them at least 250,000 tons; besides which, China could take an unknown quantity at such a price as they could afford to sell it for.

A great part of this population is fed on rice, for which they pay about 120 rupees a ton, while they could get it from the irrigated Delta for 30. They also pay 100 rupees a ton for salt, which they could get by the river for 35. Again, they grow wheat at 20 rupees a ton, which, if conveyed to the coast by the river, would be there made into flour by the water power, and would be then worth about 80 rupees a ton, whilst the cost of transit and grinding, and loss in weight, would not exceed 15 rupees.

In the Delta there are about 600,000 people, occupying an area of 3,000 square miles of the richest land, perfectly capable of bearing two millions of people. Before the new hydraulic works were commenced, their foreign trade amounted to only three or four lacs; there were scarcely any European inhabitants, and to pay a revenue of 19 lacs a year, there was an annual drain of specie from the district.

There were no internal communications whatever, excepting a very irregular one by the river, which was almost impracticable during high freshes and in the dry season, and which, of course, from its distance, was of no use at all to by far the greater part of the Delta.

There is an excellent port at Coringa; but owing to there being only nine feet of water over the bar of the river, it can be made scarcely any use of for repairs.

The district is thus almost entirely shut out from European enterprise and capital.

Now let the following sums be expended upon water-works, viz.—

	Lacs.
Storing 3,000 million cubic yards of water, improvements in the bed of the river, &c.	20
Ditto hydraulic works	25
Deepening bars, &c.	1
	46

or we may allow half a million sterling.

The following may then be the changes that will take place:—

A trade in cotton of at least 150,000 tons a year will rapidly spring up, bringing in an income of 300 lacs to the upper Godavery districts. Probably as much rice will be imported, saving them nearly 150 lacs a year; and even the present population would

consume about 100,000 tons of salt, in which there would be a saving of 65 lacs a year. They would also sell perhaps 100,000 tons of wheat, producing an income of 20 lacs even at the present rate. With this vast export and import trade of four millions sterling in value of goods, there would of course be an extensive settlement of European merchants throughout that fine country, which, though excessively hot for three months in the year, has an exceedingly pleasant climate for the other nine. Thus the foundations would be laid for bringing European influence to bear fully upon the native population, and an immense demand would inevitably spring up for every kind of English manufactures. As soon as ever they become settlers they must needs become buyers also. Would not this connection with Europeans, in God's providence, lead to the improvement of the people in every respect?

Again, were the people in the Delta provided with an unlimited supply of water for irrigation, with 1,000 miles of water-communication within the Delta, and thus with the means of growing sugar, rice, chillies, &c., at prices which must give them the command of almost all markets, with an immense demand for all their peculiar products, salt, &c., in the upper parts of the basin, with a safe port, affording advantages for repairs over almost every port in the world on account of the cheapness of labour, &c.; a people so situated must necessarily

become rapidly a wealthy community, and increase so as to fully occupy the whole Delta.

A vast mercantile city, with a trade of two or three millions sterling, would be formed on the bay of Coringa, and extensive establishments for building and repairing ships would follow. Numerous sugar manufactories, and water-power mills for grinding, and various purposes, would also be erected.

Is there not fair ground for supposing that all this prodigious change would take place solely by turning to account the water that now flows uselessly into the sea?

I may also mention two facts bearing upon the case. One is, that within a few months of the time that the water was turned into one of the divisions of the Delta in which sugar was an article of produce, the cultivation was increased four-fold, though only a small extent of capital was out. The other is the following statement of transit required by one of the sugar works in this Delta. While manufacturing 2,000 tons of sugar per acre, it requires to convey

	Tons.
8,000 tons of jaggery, thirty-five miles	105,000
2,000 tons of sugar, thirty-five miles .	70,000
10,000 tons of firewood, thirty-five miles	350,000
Tons carried one mile . .	525,000

This is now all carried by water; to convey it by land (when the country is dry enough for it to be moved at all) would cost two annas a mile, or 66,000 rupees. This is equivalent to a charge of 3*l.* a ton on the sugar, and is sufficient to make the difference of works being highly profitable, or to cause a total loss of the capital sunk.

If this fact be not sufficient of itself to prove what India loses from want of cheap transit, what could prove it? These works are not situated 500 or 1,000 miles in the interior, but in one of the coast districts, and only thirty-five miles from the port; and yet the want of water-carriage would alone be sufficient to turn the scale, whether capital would be invested in this way with a large profit, or whether the whole would be lost. This difference in the cost of carriage would be 16½ per cent. upon a capital of 40,000*l.*, which may have been the sum invested. And of course this sum of money saved does not measure the value of the water-carriage, which is always available; because, when the Delta was under cultivation, and flooded in all directions by the monsoon, there being no practicable road, the materials could not be carried at all by land. In a neighbouring district there are works capable of making 4,000 tons of sugar a year, situated about forty miles from the coast, and some of the jaggery is carried thither from a very great distance. I suppose that water-carriage for those works would make a difference of

more than 10,000*l.* a year. Even if that district were fully provided with railways, there would be a loss to the owners of these works of more than 3,000*l.* a year as compared with water-carriage, supposing the railways worked at the lowest rates proposed by their advocates, viz., eight pice, or 1*d.*, per ton.

I may here also call attention to the fact, how small the importance of cheap power for manufactures, &c., is, compared with cheap transit and cheap produce. The water, which by the above calculations would save 250 lacs a year in providing navigation and irrigation, would only save eight lacs a year by substituting water power for steam to the extent of 4,000 horse power for the whole twenty-four hours, or 40 lacs if substituted for the same amount of bullock power. At these rates the Godavery navigation would be equal in value to 76,000 steam horses'-power working the whole twenty-four hours. And the use of 9,000 million cubic yards in the Delta for irrigation would, at the rate of 300 cubic yards per rupee, be equal in value to 150,000 steam horse-power. This is calculated to show the immense comparative importance of communications to a country above steam power, for manufacturing, &c., even could it be had for nothing.

It would seem almost impossible for any person to examine the circumstances of this basin of the Godavery without being convinced that no known mine in the world could compare with the value of this

water-mine. We may safely reckon that 50 lacs, or half a million sterling, spent on it, will within a few years produce property of the value of 250 lacs a year, the interest of 60 millions sterling, or 120 times the amount expended; while the gold-mines of Port Phillip only produce four times the amount expended in working them: and this too without the tremendous evils connected with gold-mining.

It is evident that when once a weir is constructed across any river, the whole upper part of the basin of that river becomes available for storing water, and an immense extent of country is open for selection of sites for reservoirs to retain water for irrigation, and it is no longer necessary to construct an irrigation-tank on the spot where the cultivation is to be carried on. Wherever a site can be found which will afford great capacity with a short bund, the water may be stored and allowed to flow down the natural water-courses and the river to the weir, from which it will be led by channels to the cultivable land. Many of the large rivers of the Peninsula are so circumstanced; for instance, the Tumbrapauny, the Vigay, the Cauvery with its branches, the Ambravutty, the Noel and the Bowany, the Vellaur, the Chennaur, and the Godavery; and weirs are now building on the Kistnah and the Pennaur, and estimated for on the Pallaur. This opens an unbounded field for improvement; and were there but one-fifth part of the number of civil

engineers that are required in the Presidency, the country ought immediately to be examined for such sites for tanks. As a specimen of the difficulties that engineers had to contend with in times past in trying to get the Government to take advantage of the magnificent capabilities of the country, it may be mentioned here, that at one time the construction of such tanks on the Neilgherries, where there are remarkably fine basins available, was pressed upon the authorities; and, besides many almost equally ludicrous objections that were officially stated to the project, the question was triumphantly asked: "How could it be known where the water from such tanks would flow to?" the objector being perfectly satisfied in his own mind that it was beyond the capacity of man to ascertain whether a certain stream flowed towards the east or the west coast. Upon exactly such grounds as this have innumerable plans for improving the country been rejected by those who were fully satisfied that they were the ablest men of their day. In this respect almost the whole Peninsula is ready for the construction of magnificent reservoirs on all its great rivers, the water from which would be at once applied to the land by means of the rivers and channels already existing in the plain country. All such channels are more or less imperfectly supplied with water at present even during the rainy season, and the whole are either very partially or not at all supplied during the dry season.

I may here also, as another example, give a sketch of what may yet be done, by means of water, for the best irrigated district in India, Tanjore, already so often referred to. This district contains 700,000 or 800,000 irrigated acres, which are pretty well supplied with water for six months in the year, though not without occasional deficiencies; but for three or four months scarcely any water flows through it.

Some use is also made of the Cauvery and Colleroon, and their branches in the Delta, for navigation; but this is precarious, even during the rainy season, and quite stopped during the dry months. At least a million cubic yards per hour could be profitably employed in this district for six months of the year, in addition to its present supply; besides a considerable quantity to supply occasional deficiencies during the rains.

Thus 5,000 million cubic yards of water could be stored with immense advantage for this highly-irrigated district. This would not only allow of the cultivation of sugar to any extent (which is at present almost impracticable, from the supply of water not continuing long enough for a ten or eleven months' crop), and thus give the district its grand desideratum, a new article of foreign commerce; but it would also furnish it with several lines of river navigation through the very heart of the district to the coast. The rivers within the limits of the district have a fall diminishing from three

feet to one foot per mile, and though they would not afford anything like such a navigation as would be obtained by means of a steam-canal, yet they would at once and effectually relieve the district from its present intolerable burthen of land transit, at 2½ annas per ton. As a specimen of what this burthen is on one item of trade which now exists, notwithstanding such a hindrance, the following calculation is given: About 60,000 tons of rice are exported to Ceylon annually, which is probably brought on an average thirty miles, at a cost of nearly three lacs a year. Certainly five-sixths of this might be saved if the rivers were permanently navigable.

But by means of a stream of a million cubic yards an hour, not only would the branches of the river within the Delta be rendered navigable, but the navigation would be extended inland to near Bowany in Coimbatore, or about 180 miles from the sea, from which point it is now navigated at intervals during the freshes by means of basket-boats. At least 500 miles of river navigation would thus be provided, amidst one of the most dense populations in the world. A line of canal about fifty miles in length has already been formed in the direction of Madras, from the heart of the district, and connected with the Cauvery, and the extension of this along the coast for twenty miles has now been ordered. About 100 miles of exceedingly easy

country along the line of back waters to Madras, would connect all this system of river navigation with Madras, and thus unite the place of greatest consumption with the richest producing tract.

To store 5,000 millions of cubic yards for this purpose would cost about 30 lacs; and perhaps a lac might be spent with advantage in trifling alterations to the rivers. It would not, of course, be advisable to go to a great expense in improving the rivers for navigation, because it would be better ultimately to make regular canals. But in providing this water for the improvement of irrigation, the great object of relieving the country from the main part of the burthen of cost of transit would be attained. Though I have stated the cost of the whole supply of 5,000 million cubic yards at 31 lacs, yet it must be remembered, that a very small part of this, or about three lacs, would suffice to keep the rivers steadily supplied to a good depth during the present cultivating season, or for about seven months of the year, both securing the present crops from drought, and keeping a constant navigation open for that period at least.

Thus about three lacs spent on the remaining line of the coast canal to Madras, and five lacs on an improved supply of water, would even, if nothing further was done, make an immense difference to this important district, even in money receipts; and

the effect of a rapid steam communication with the city of Madras would be an advantage of far greater importance.

This is a sketch of what is still wanted, in the way of water, in the only district in India at all tolerably supplied with that fundamental article.

An outlay of only five lacs would give it, besides this vast addition of water for irrigation, 300 miles of inland navigation for seven months of the year, while New York has been content to pay 30 million of dollars (650 lacs of rupees) for 365 miles of canal open during the same period of the year. If only 50,000 tons a year were carried over this 300 miles, it would be a saving to this part of the country of 35 lacs a year, as compared with land carriage; and the additional water for irrigation (1,000 million cubic yards) would be worth 10 or 15 lacs a year.

This part of the paper may well be closed with a few lines on the water-works in Rajpootana, as given in Captain Baird Smith's work on irrigation. These consisted chiefly of tanks, and though on a very small scale, and constructed in a very expensive manner, yet they have produced such magnificent proportional results, not only in rescuing the population from all the horrors of a state of disorganization, poverty, and liability to famine, but even in direct and immediate returns in money to the state, that they furnish another clear and undeniable proof

of the value of water. These tanks were chiefly formed by very massive walls of rubble in mortar, generally backed by earthen embankments. The largest of those in Marwarree is stated to have covered a third of a square mile, and to have been about eight yards deep at the lowest point of the bed. The capacity is not given, but the mean depth would thus probably be above 2½ yards, and the contents 2½ million cubic yards. The total area of all the tanks constructed in Marwarree is given at fifteen square miles; and taking the mean depth of the whole at two yards, the total of water stored in them would be 90 million cubic yards; and the cost stated at 24,000*l.*, would give 375 cubic yards per rupee of capital, or, taking interest at four per cent., the cost of water would be 9,400 cubic yards per rupee, which, allowing for the very small scale, and the very expensive mode of construction, agrees well enough with the calculated cost of water in other parts of India.

The results of this expenditure also fully supports all that is said of the value of water in India, as deduced from results in the Peninsula, and in the north-west. The income of Government revenue had, in 1847, reached 11,000*l.* a year, or 47 per cent. Taking the tax at one-third the produce as stated, this would imply a further profit to the people of 94 per cent., making the total returns for the capital 141 per cent., though there can be no doubt

that with more experience in such works, the same quantity of water might have been reserved at a half or a third of the actual cost, in which case the returns would have been 300 or 400 per cent., even with tanks on so very small a scale as these, the largest of which appears not to have been the twentieth part of the size of many of the old tanks in the Peninsula.

Again, in the adjoining district of Ajmere, 112 tanks, covering an area of 20 square miles, and containing perhaps 120 million cubic yards, cost 38,000*l.*, and yielded an additional revenue of 10,000*l.* in the fourth year from the commencement; the cost of the water being thus about 8,000 cubic yards per rupee, allowing four per cent. for interest of capital, and the returns in revenue to Government about 26 per cent., or probably 100 per cent. in all; Captain Smith estimating the benefit to the people at nearly three times the increase of revenue.

It is of the utmost importance to observe that these, as well as other isolated improvements by means of water, have been made solely in consequence of the earnest applications of the local officers, or the subordinate boards; and this is the evident reason why there has been no general system of irrigation improvements carried on throughout the whole of India. Not only have these works not been suggested or ordered by the authorities at home, in the first instance, but even these wonderful results,

from every isolated case, have been totally insufficient to awaken the authorities to a sense of the importance of the subject.

Who would not suppose that such a case as this of Marwarree and Ajmere would lead at least to the question being asked, "May not these magnificent results, calculated to benefit the people so immeasurably, and at once to relieve us from all our intolerable load of anxiety about the finances, be obtained by like means throughout India?"* And

* The scope and success of Colonel Dixon's measures have been sufficiently indicated in the preceding pages. Though much was done by his predecessor for the civilization of the Mairs, yet undoubtedly all this was most precarious, and their subsistence and employment were dependent upon most uncertain seasons; and the development of a great system of irrigation works (by which the fallen rain is economised to the utmost, and distributed in time and place of need, instead of sweeping down the valleys and passing away in a useless torrent), has been the means of giving permanence and advancement to the people.

By these works the country has been fortified against the miseries of famine; tracts of wild jungle have been converted into fertile fields, dotted with villages, and alive with rural industry; population and revenue have more than doubled; families, which for generations had abandoned their native hills, have returned to seek their traditional landmarks; the inducement to constant migration and unsettled habits done away, and a taste acquired for the sweets of profitable toil. The wild unmastered extremes of 1820 are thus found to have become in 1843

should not a department be created for the express purpose of planning and superintending similar works in all parts of the empire—a department to facilitate the provision of the revenue collected, and by which themselves and all the rest were to be paid? Yet till the matter is seen so far in its true light as to lead to the appointment of such a Board, India will never flourish. At present, for want of such a department, while one officer is employed in cutting a canal, and another a railway, a third is very busy making a grand road parallel with each.

While writing about water in India, it ought not to be forgotten that fresh water is not her only treasure; the salt water is also of incalculable value. Salt is at once a great source of revenue, and a necessary of life to a hundred million of peoples. It has been hitherto obtained at a very low cost, viz. about two rupees, or 4*s.* a ton; but this has been by the native method, without the least aid from Europeans. The native mode of manufacturing is open to the same objections as their other operations, viz. that of carrying it on upon too confined a scale, and without capital. They think it impossible to manufacture it, excepting in the very lowest lands, on account of the expense of conveying and raising

a thrifty, thriving, peaceful, and industrious peasantry, an example to their neighbours, whose terror they once were."—*Capt. B. Smith*, p. 425.

the sea-water, and consequently they incur many far greater expenses, especially as they are always liable to have the whole harvest destroyed by floods.

The following calculations will show in what enormous quantities salt may be manufactured, of the purest quality, and at the most trifling cost. Sea-water contains three per cent. of salt; or a cubic yard weighing 1,700 lbs. yields 50 lbs. Fully-saturated brine contains 30 per cent., or 500 lbs. in the cubic yard. A square mile of plain is equal to three million square yards, and consequently a square mile of area, one yard deep, will yield nearly 70,000 tons of salt—or we may allow 60,000. The evaporation in the Carnatic, during the months of March, April, and May, is nearly half an inch a day on an average, and probably in extensive and very shallow reservoirs it would be quite that. We may safely reckon that a yard depth will be evaporated in less than three months. If, therefore, a convenient plain, a mile square, from five to ten feet above the sea, were chosen, and enclosed by a bank a foot or two feet high, and if, adjoining to that, a second area were enclosed, of about one-tenth its extent, or 550 yards square, the sea-water might be raised into the first in such quantities as to keep it always near the point of saturation; and it might, as fast as it reached that point, flow off into the smaller area, where it would be allowed to evaporate entirely, so that when the amount of evaporation amounted to

one yard in depth, there would be 500 lbs. of salt on every square yard of ground.

Care should be taken to obtain the water in the first instance as clear as possible, and while standing in the first reservoir it would deposit every remaining particle of *silt*, and flow off into the smaller one in a state of great purity.

The total quantity of water that must be raised to give this quantity of 60,000 tons of salt, would be three million of cubic yards, or 5,000 million of pounds; and as a one horse-power of engine will raise at least three million pounds one foot high per hour, it would only require one horse-power for 1,700 hours, or 140 days, to raise the whole quantity one foot, or 700 days to raise it five feet; or eight horse-power to do the same work in three months. The cost of working an eight-horse engine in such situations would be about 400 rupees a month, allowing 20 per cent. for interest and wear and tear, and charging the year's interest to the three months. This would give 1,200 rupees for the cost of raising to the height of five feet water sufficient to yield 60,000 tons of salt, or at a cost of 50 tons for a rupee, or four pice per ton. If bullock power be used, we may take it at 800 cubic yards raised five feet for a rupee, or 4,000 rupees for 60,000 tons of salt, equal to about one anna per ton. This will show that the cost of raising the water is an insignificant item.

Again, to lead the water to a convenient place

would be quite a trifling expense. To cut a channel one yard wide at the bottom, and two yards deep, would cost about 300 rupees a mile; so that if it had to be cut several miles, and were only used one year, it would only amount to one or two pice a ton on a manufacture of that extent. The expenses of collecting, also, from a surface of something more than a quarter of a mile square, would be equally trifling.

If the site chosen for the manufacture were thus a few feet above the level of tide-water, it would not be liable to be submerged, and the only evil arising from untimely rains would be, that two or three inches of water would fall in the reservoirs, which would take a few days to evaporate. There are vast plains suitable for such works along the coast. In Tanjore, especially, near Port Calymere, there is a plain containing perhaps 50 square miles, in which salt could be manufactured on a magnificent scale, and probably at three or four annas a ton. That tract also has the advantage of water from the Bay of Tondi, where, from its sheltered position, it is as clear as crystal. And the coast there is also peculiarly favourable for shipping the salt, as there is smooth water, and consequently no surf. The coast canal, when completed, will materially facilitate the manufacture also, because almost any point on the whole extent of coast may be taken, wherever the circumstances are most favourable, when the salt can be conveyed to any other point, at the rate of

about a rupee a ton for 400 miles. The idea of Cheshire competing with India for this trade is most absurd, unless some advantage, direct or indirect, be granted to the former. There is only one important caution to be given on this subject, and that is, that fresh water must never be used. Lately, the salt manufacturers reported to the collector of Masulipatam, that they had commenced their operations as usual, that the evaporation had proceeded as it had done in former years, but that not a particle of salt was produced. On careful investigation it was found that the creeks from which they had been in the habit of obtaining their supplies of water, were all filled with fresh water from the channels leading from the Annicut in the Godavery, which was the only way in which this phenomenon could be accounted for.

When we consider the magnitude of the field, and the trifling sum that has been spent upon its improvement, we are warranted in asserting, that public works have been almost entirely neglected in India. The work that ought to have been spread over a hundred years must, if we wish to redeem our character, be done in the next ten; to do this will call for the utmost energies of men in full possession of all their faculties. Hitherto the only mistake of any consequence that has not been

guarded against is, that of *doing nothing.* The Board of Irrigation and Navigation ought to have written on the paper-stand, in front of each member and secretary, in large letters, "Do IT, DO IT, DO IT."

The motto hitherto has been, "Do nothing, have nothing done, let nobody do anything. Bear any loss, let the people die of famine, let hundreds of lacs be lost in revenue, for want of water, or roads, rather than *do* anything." It is not the loss of the money that we mind, that is nothing; we can afford to lose millions every year for want of hydraulic works, and therefore to spend a few lacs of rupees on such works would, of course, be nothing; but nothing must be *done.* Before anything is *done,* a matter must be brought before the collector, who has charge of the welfare, and in a great measure the lives, of a million of people, and of a revenue of 30 or 40 lacs a year; but he shall not be permitted to spend 100*l.* He hands it on, therefore, to the Board of Revenue; but they have no power to sanction an expenditure of 100*l.* It travels from the Board of Revenue to the Local Council, but the hands of that council are tied if the project involves an expenditure beyond 1,000*l.*; it must be passed on, therefore, to the Supreme Council,—a tribunal ignorant of the wants, and dead to the interests of those extensive kingdoms which are called minor presidencies, and which is glad enough to avoid the inconvenience

and responsibilities of expenditure, by referring the project to the authorities at home; and on its arrival at home, it has to undergo the ordeal of two more Boards.

Who would not suppose, from these excessive precautions, that at least fifty districts had been ruined by works of irrigation and communication, and that now the only fear was, that anything further should be done? Who would believe that, without half a dozen miles of real turnpike road,—with communications generally in the state that they were in England two centuries ago,—with periodical famines and a stagnant revenue,—the stereotyped answer to any one who urges on improvement is, "He is too much in a hurry;" "He is too sanguine;" "We must go on by degrees;" and this, too, in the face of the fact, that, almost without exception, money laid out upon public works in India has yielded money returns of 100, 200, 300 per cent., besides immeasurable other advantages to the community.

What should we think of the owner of a heavily mortgaged, but improveable estate in England, who, with means at his command of doubling his income, should be afraid of arriving at that result "too soon?" The only difference between the private landlord in England and the public landlord in India, is, that whilst the one may have an interest in a single square mile, the interest of the other extends over a million. The more extensive the field, the greater

the need for energy and enterprise. We have already all but lost one century, to the great damage of our finances, and the greater injury of the people. Should we then lose another century, by continuing to crawl? or shall we make a strenuous effort to redeem the time we have lost, by working double tides, until we have fully developed the resources of our magnificent estate? The millions that we are about to spend upon a few costly and high-speed railways would accomplish that object, to the great profit of the shareholders, of the people of India, and of the public treasury.*

* It appears, from the papers recently laid before Parliament, that a project has been broached by the Superintendant of Marine of Calcutta, Captain Rogers, for making the "Chilka lake," near Ganjam, in the northern Circars, the port of Calcutta, and to connect the two by a railway. But if the Ganges canal should be continued to Calcutta, as here proposed, its prolongation to the "Chilka lake," and the execution of a fresh canal from the southern end of the lake, to join the canals leading from the Godavery, would connect Calcutta with Madras, and give us, if the plan proposed in these pages should be carried out, an uninterrupted still-water communication from the upper provinces of Bengal to the Malabar coast.

THE END.

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